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PART III—ABSTRACTS

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45th INDIAN SCIENCE CONGRESS, MADRAS, 1958

SECTION OF MATHEMATICS

PRESIDENT : PROF. B. S. MADHAVA RAO, D.Sc.; F.N.I.

Abstracts

1. The origins of Trigonometry

U. C. BARDHAN, Calcutta.

In the Vedas, Puranas and other works trigonometry can be traced, also in the works of early Indian mathematicians and astronomers, and in the Sulvasutras. Barahamihir, Brahma Gupta, Bhaskara, Munjala and others seem to have written on trigonometry. Spherical trigonometry was treated scientifically by *Aryabhata* (475-550 A.D.) in his *Aryabhatiyam and Gola*. Next comes Varahamihir whose work Pancha Siddhantika shows an advanced state of mathematical learning. *Panlisa Siddhanta* contains an excellent summary of nearly Indian trigonometry. The cosine and sine theorem for oblique angled spherical triangles are implied in the rules of Varahamihir. Bhaskara gave a method of constructing a table of sines for every degree. Paulime Sperry, Ph.D , says, "it is possible they (Indians) invented the beginnings of trigonometry for themselves.... To them (Indians) we owe the introduction of the sine, cosine and versed sine".

2. New Theorems in the Theory of Numbers.

S. L. SRIKANTAIYA and C. S. RAMAN, Mysore.

A method of effecting a Q-Partition (no two elements of the partition being equal) is developed, defining the elements of the partition as "Special Elements" of the set of positive integers. Introducing the idea of a "Special index", two theorems are deduced.

3. The summation of certain series involving the sum $H_n = 1+\frac{1}{2}+\frac{1}{3}\ldots+\frac{1}{n}$

K. RAMACHANDRA, Bangalore.

The object of this paper is to obtain the summation of certain interesting series of the forms

$$\sum_{n=1}^{\infty} H_n^4 \Big/ (n+1)(n+2); \quad \sum_{n=1}^{\infty} H_n^2 \Big/ 2^n; \quad \sum_{n=1}^{\infty} H_n \Big/ (n+1)^k;$$

and

$$\sum_{n=1}^{\infty} H_n^2 \Big/ (n+1)(n+2)\ldots(n+k)$$

4. An aspect of local property of $|R, \log n, 1|$ Summability of Trigonometrical series

Sri Nivas Bhatt, Allahabad.

Let $f(t)$ be a periodic function with period 2π and integrable (L) over $(-\pi, \pi)$, and let the Fourier series of $f(t)$ be

$$f(t) \sim \tfrac{1}{2} a_0 + \Sigma(a_n \cos nt + b_n \sin nt) = \Sigma A_n(t).$$

Mohanty and Izumi have independently proved that the summability $|R, \log n, 1|$ of a Fourier series is not a local property of the generating function. Very recently they have proved (Tôhoku Math. Jour (2) Vol. 8, 1956, pp. 201-4) that if

$$\Sigma\, A_n(x) \log \log n/n < \infty, \qquad \ldots \quad (1.1)$$

then the summability $|R, \log n, 1|$ of a Fourier series depends only on a local condition. In Theorem 1, the author has replaced the condition (1.1) by a less stringent condition, namely,

$$\Sigma\, A_n(x)/\{n \log n\} < \infty.$$

2. The author has also established that if $\{\lambda_n\}$ is a convex sequence such that $\Sigma\, n^{-1} \lambda_n$ is convergent, then the summability $|R, \log n, 1|$ of the series $\Sigma\, A_n(t) \log n\, \lambda_n$ at a point can be ensured by a local condition. This is a necessary consequence of the following.

Theorem 2. *If* $\{\lambda_n\}$ *is a convex sequence such that* $\Sigma\, n^{-1}\lambda_n$ *is convergent and the series* $\Sigma\, a_n$ *is bounded, then the series* $\Sigma\, a_n \log n\, \lambda_n$ *is summable* $|R, \log n, 1|$.

5. On the Absolute Summability Factors of a Fourier series and its Conjugate series

Ganesh Datta Dikshit, Allahabad.

1. Let $f(t)$ be a periodic function with a period 2π, and integrable (L) in $(-\pi, \pi)$. Without loss of generality the Fourier series of $f(t)$ may be assumed to be

$$\sum_{1}^{\infty} (a_n \cos nt + b_n \sin nt) = \sum_{1}^{\infty} A_n(t).$$

Then the conjugate series of the Fourier series of $f(t)$ is given by

$$\sum_{1}^{\infty} (b_n \cos nt - a_n \sin nt) = \sum_{1}^{\infty} B_n(t).$$

We write

$$\phi(t) = \tfrac{1}{2}[f(x+t) + f(x-t) - 2f(x)],$$

$$\psi(t) = \tfrac{1}{2}[f(x+t) - f(x-t)].$$

2. The idea of summability factors applicable to the absolutely summable Fourier series, originated by Prasad, was developed by various authors like Izumi and Kawata, Chow, Cheng, Pati, Prasad and Bhatt, Pramila Srivastava and others. Generalizing the theorems of Cheng (Duke Math. Jour., 14, (1947)) and 15, (1948, pp. 17-27), the following two theorems have been proved.

Theorem 1. *If $\{\lambda_n\}$ is a convex sequence such that the series $\Sigma\, n^{-1}\lambda_n$ is convergent, then the series $\Sigma\, \lambda_n A_n(x)(\log n)^{-\beta}$ abd $\Sigma\, \lambda_n B_n(x)(\log n)^{-\beta}$ are summable $|C, \alpha|$ for every $\alpha > 1$, provided that*

$$\left.\begin{aligned}\int_0^t |\phi(u)|\,du &= O\left[t\left(\log\frac{1}{t}\right)^{\beta}\right]\\ \text{and}\qquad \int_0^t |\psi(u)|\,du &= O\left[t\left(\log\frac{1}{t}\right)^{\beta}\right]\end{aligned}\right\}\ (\beta \geqslant 0),$$

as $t \to o$.

Theorem 2. *Under the hypotheses of Theorem 1, the series*

$$\Sigma\, \lambda_n A_n(x)/n^{1-\alpha}(\log n)^{\beta}$$

and

$$\Sigma\, \lambda_n B_n(x)/n^{1-\alpha}(\log n)^{\beta},$$

are summable $|C, \alpha|$ for $o \leqslant \alpha < 1$.

6. On the Cesàro non-summability of a series conjugate to Fourier series

(Km.) SULAXANA KUMARI, Allahabad.

1.1. Let the Fourier series of a Lebesgue integrable periodic function $f(\theta)$ be

$$f(\theta) \sim a_0/2 + \sum_{n=1}^{\infty}(a_n \cos n\theta + b_n \sin n\theta) \qquad \text{.. (1.11)}$$

and the series conjugate to the above Fourier series be

$$\sum_{n=1}^{\infty}(b_n \cos n\theta - a_n \sin n\theta). \qquad \text{.. (1.12)}$$

Let

$$\psi(t) = \tfrac{1}{2}\{f(x+t)-f(x-t)\},\ \Psi_{\alpha}(t) = \frac{\alpha}{t^{\alpha}}\int_0^t (t-u)^{\alpha-1}\,\psi(u)\,du,\ \alpha > 0.$$

Following theorems regarding the Cesàro non-summability of (1.12), at a point $\theta = x$, have been proved by means of negative examples.

Theorem 1. *The conditions*

(i) $$\eta(t) = \int_0^t \psi(u)/u\,du = O\left(1/\log\frac{1}{t}\right),\ \text{as } t \to o,$$

where the above integral exists if the upper limit t is a constant > 0,

(ii) $$\int_0^t \eta(t)\,dt = O\left(t/\log\frac{1}{t}\right),\ \text{as } t \to 0,$$

and the existence of the conjugate function

$$\frac{2}{\pi}\int_0^{\infty}\frac{\psi(u)}{u}\,du, \qquad \text{.. (1.13)}$$

are not sufficient for the $(C, 1)$ summability of (1.12), at $\theta = x$.

Theorem 2. *The conditions*

(i) $$\psi_\alpha(t) = O\left(1/\log\frac{1}{t}\right), \text{ as } t \to 0,$$

(ii) $$\int_0^t \psi_\alpha(u)du = o\left(t/\log\frac{1}{t}\right), \text{ as } t \to 0,$$

and

(iii) $$\frac{2}{\pi}\int_t^\infty \psi_{\alpha-1}(u)/u\, du \to s, \text{ as } t \to 0, \text{ for } \alpha > 1,$$

$$\frac{2}{\pi}\int_t^\infty \psi(u)/u\, du \to s, \text{ as } t \to 0, \text{ for } \alpha \leqslant 1,$$

do not necessarily imply the (C, α) *summability of* (1.12), *at* $\theta = x$.

Theorem 3. *The existence of the conjugate function* (1.13) *and the convergence of the integral* $\int_0^\delta \psi(u)/u^{\rho+1}\, du$ *are insufficient to imply* $(C, 1-\epsilon')$ *summability of* (1.12), *at* $\theta = x$, *for* $\epsilon' > \rho/(1+\rho)$, $\rho > 0$.

7. On the Logarithmic means of the conjugate series of a Fourier series of a Discontinuous function.

(Miss) SULAXANA KUMARI, Allahabad.

1. *Definition.* A series Σc_n is said to be summable $(R, \log \omega, k)$ to sum S, if

$$R_k(w) = (\log \omega)^{-k} \sum_{n<\omega}\left(\log\frac{\omega}{n}\right)^k c_n,$$

tends to a limit S, as $w \to X$. $R_k(w)$ denotes the $(R, \log w, k)$ mean of Σc_n.

Let the conjugate series of the Fourier series of $f(\theta) \epsilon (L)$ in $(-\pi, \pi)$ and periodic with period 2π, be

$$\sum_{n=1}^{\infty}(b_n \cos n\theta - a_n \sin n\theta) = \sum_{n=1}^{\infty} B_n(\theta), \tag{1.1}$$

and r-th derived series of the above conjugate series be

$$\sum_{n=1}^{\infty}\frac{d^r}{d\theta^r}B_n(\theta). \tag{1.2}$$

Suppose that $P(t)$ is a polynomial of $(r-1)$th degree in t, such that

$$P(t) = \sum_{i=0}^{r-1}\frac{d_i}{i!}t^i,$$

and $$h(t) = \frac{1}{2t^r}\left[\{f(x+t) - P(t)\} - (-1)^r\{f(x-t) - P(-t)\}\right],$$

d_i's being constants independent of t, and $h(t)$ is integrable (L) over $(-\pi, \pi)$ and periodic outside this range with period 2π.

Write $$\theta(t) = \theta_0(t) = \tfrac{1}{2}\{f(x+t) - f(x-t)\} - l, \; l \text{ being a constant};$$

$$\theta_\alpha(t) = \alpha\left(\log\frac{1}{t}\right)^{-\alpha}\int_t^\pi\left(\log\frac{u}{t}\right)^{\alpha-1}\theta(u)/u\, du, \; \alpha > 0,$$

and define $h_\alpha(t)$ in a similar way.

The following theorems have been proved.

Theorem 1. *If, for* $-1 < p < \infty,\ \delta \geqslant 0$

$$\int_t^\pi |\theta_\delta(u)|/u\, du = o\ \{(\log \tfrac{1}{t})^{p+1}\},\ \text{as } t \to 0,$$

then $R^\delta_\omega = \dfrac{2l}{\pi(\delta+1)} \log \omega + o\,\{(\log \omega)^{p+1}\}$, *as* $\omega \to \infty$ where R^δ_ω *denotes the* $(R, \log w, \delta)$ *mean of* (1.1), *at* $\theta = x$.

Theorem 2. *If*

and
$$\int_t^\pi |h(u)-S|\ /u\, du = o\left\{\left(\log \frac{1}{t}\right)^r\right\},\ \text{as } t \to 0,\ \text{for } r \geqslant 1,$$

$$\int_t^\pi |h_{r-1}(u)-S|/u\, du = o\left(\log \frac{1}{t}\right),\ \text{as } t \to 0,$$

then $\left[R^r_r(\lambda\,\omega) - R^r_r(\omega)\right] = \dfrac{2S}{\pi}\,\dfrac{r\,!}{(r+1)}\ \log \lambda,\ \lambda > 1$, *where* $R^r_r(\omega)$ *denotes the* $(R, \log w, r)$ *mean of* (1.2), *at* $\theta = x$.

8. On the multiplication of absolutely summable Dirichlet's Series

B. N. PRASAD and T. Pati, Allahabad.

1. *Definitions.* If $(A) \Sigma a_n e^{-\lambda_n s}$ and $(B) \Sigma b_n e^{-\mu_n s}$ (s complex) be any two general Dirichlet's series, their formal prouct, called the Dirichlet product, mty be written as

$(C) \Sigma c_n e^{-\nu_n s}$, where $c_n = \sum\limits_{\lambda_p+\mu_q=\nu_n} a_p b_q$, and $\{\nu_n\}$ is the ascending sequence formed out of all the values of $\lambda_p+\mu_q$ $(p, q = 1, 2, 3, \ldots)$.

Let Σa_n be a given infinite series, and let λ_n be a positive monotonic increasing sequence , tending to infinity as n tends to infinity. We write

$$A\lambda(\omega) = A^0_\lambda(\omega) = \sum_{\lambda_n \leqslant \omega} a_n\ ;\ A^r_\lambda(\omega) = \sum_{\lambda_n \leqslant \omega} (\omega-\lambda_n)^r a_n\ (\gamma > 0).$$

The series Σa_n is said to be summable $|R, \lambda_n, r|_r \geqslant 0$, if $A^r_\lambda(\omega)/\omega^r \varepsilon BV(A, \infty)$, where A is some finite positive number.

2. The object of the present paper is to study the behaviour of the $(R, \nu_n, k+k')$ -mean of the Dirichlet product series (C), at $s = 0$, that is, Σc_r, when (A) and (B) are respectively summable $|R, \lambda_n, k|$ and $|R, \mu_n, k'|$ $k, k' > 0$, for $s = s_1$ and $s = s_2$.

3. We establish the following theorem.

Theorem. *If* k *and* k' *are positive integers,* $\Sigma a_n e^{-\lambda_n s_1}$ *is summable* $|R, \lambda_n, k|$ *and* $\Sigma b_n e^{-\mu_n s_2}$ *is summable* $|R, \mu_n, k'|$, *where* $Rl\ s_2 \geqslant Rl\ s_1 > 0$, *then*

$$e^{-sx} x^{-(k+k')} C_{k+k'}(x)\ \varepsilon\ BV(h, \infty),$$

where h *is some finite positive number, for all* s *on the line* $Rl\ s = Rl\ s_2$.

9. A Theorem on the absolute Cesàro summability of Fourier series and some interesting Consequences

S. R. SINHA, Allahadad.

It was proved by Bosanquet (P.L.M.S., 37, 1934, 17-32) that a necessary and sufficient condition, that the Fourier series of $f(t)$, at $t = x$, should be summable $(C, \alpha+\delta)$ to S, is that the Fourier series of $\phi_\alpha(t)$, at $t = 0$, should be summable (C, δ) to S, where α is a positive integer and $\delta > 0$. We establish the following theorem, as an analogue of this result of Bosanquet, for absolute Cesàro summability :

Theorem 1. *The necessary and sufficient condition that the Fourier series of $f(t)$, at $t = x$, be summable $|C, \alpha+\delta|$, where α is a positive integer and $\delta > 0$, is that the Fourier series of $\phi_\alpha(t)$, at $t = 0$, is summable $|C, \delta|$.*

We make use of the sufficieny part of Theorem 1 to establish Theorem 2 which concerns the bounded variation of a sequence associated with the Fourier series.

Theorem 2. *If $0 < \delta < 1$, then the bounded variation of the sequence $\{n^\delta a_n^{(1)}\}$ where $a_n^{(1)}$ is the Fourier cosine constant of $\phi_1(t)$, is a non-local property.*

Lastly, we deduce a set of criteria for absolute $|C|$-summability of the Fourier series of $f(t)$, at a point $t = x$, by means of certain of the existing criteria for absolute convergence of Fourier series, and the sufficiency part of our Theorem 1. These are given as :—

Theorem 3. *If (i) $\phi_\alpha(t) \log (k/t) \varepsilon B.V.\ (0,\pi)$, and (ii) $\{n^\delta a_n^{(\alpha)}\} \varepsilon B.V., 0 < \delta < 1$, when $a_n^{(\alpha)}$ is the Fourier coefficient of the Fourier series of $\phi_\alpha(t)$, at $t = 0$, is summable $|C, \alpha|$.*

Theorem 4. *If $| f_{\alpha-1}| \log^{+} |\alpha f_{\alpha-1}| \varepsilon L(-\pi,\pi)$, then the Fourier series of $f(t)$ is sumable $|C, \alpha|$ everywhere in the interval of definition.*

Theorem 5. *If the Fourier series of $f_\alpha(t)$ and the conjugate series to the Fourier series of $f_\alpha(t)$ are both Fourier series, then the Fourier series of $f(t)$ is summable $|C, \alpha|$ everywhere in the interval of definition.*

Theorem 6. *If $f_\alpha(t) \varepsilon \text{Lip } k$, $k > 1/2$, then the Fourier series of $f(t)$ is summable $|C, \alpha|$ everywhere in the interval of definition.*

Theorem 7. *If to every point x_0, corresponds a neighbourhood I of x_0 and $g(x) = g_{x_0}(x)$, such that (i) the Fourier series of $g(x) \sim (C, 0)$, and (ii) $g(x) \equiv f_\alpha(x)$ in I_{x_0}, then the Fourier series of $f(t)$ is summable $|C, \alpha|$.*

10. On the absolute Riesz summability of Fourier series, its conjugate series and their derived series

S. R. SINHA, Allahabad.

The problem of the absolute Riesz summability of the rapidly increasing type $e^{(\log \omega)^{1+1/\sigma}}$ $\alpha \geqslant 1$, of a Fourier series, its conjugate series and their derived series, has been recently treated by Pati in his two successive papers (Trans, Amer, Math. Soc., 76, 1954, 351-374 and Proc. Nat. Inst. Sc. India, 1957). He considers the case when α is an integer $\geqslant 1$, and establishes a number of theorems for Fourier series, its conjugate series and their derived series. The object of the present paper is to extend these

theorems of Pati by introducing a parametric constant β into the type which now is taken to be

$$\lambda(\omega) = e^{(\log \omega)^{1+\beta/\alpha}}, \text{ where } \beta > 0.$$

Theorem 1. *If α is an integer $\geqslant 1$, $\beta > 0$ and $\phi_\alpha(t)\{\log(k/t)\}^\beta$ is of bounded variation in $(0, \pi)$, then the Fourier series of $f(t)$ at $t = x$, is summable $|R, e(\omega), \alpha + \delta|$, for every $\delta > 0$.*

Theorem 2. *If α is an integer $\geqslant 1$, $0 < \beta < 1$ and if*

(i) $\psi_\alpha(t)\{\log(k/t)\}^\beta$ is of bounded variation in $(0, \pi)$ and

(ii) $|\psi_\alpha(t)|/t\ \{\log(k/t)\}^{1-\beta}$ is integrable L over $(0, \pi)$,

then the conjugate series of the Fourier series at $t = x$ is summable $|R, e(\omega), \alpha + \delta|$, for every $\delta > 0$.

Theorem 3. *If α is an integer $\geqslant 1$, $\beta > 0$ and $\gamma_{\alpha,r}(t)\ \{\log(k/t)\}^\beta$ is of bounded variation in $(0, \pi)$, then the r-th derived series of the Fourier series of $f(t)$ at $t = x$, is summable $|R, e(\omega), \alpha + \delta|$, for every integral $\alpha \geqslant r$ and $\delta > 0$.*

Theorem 4. *If α is an integer $\geqslant 1$, $0 < \beta < 1$ and if (i) $\theta_{\alpha,r}(t)\ \{\log(k/t)\}^\beta$ is of bounded variation in $(0, \pi)$ and (ii) $|\theta_{\alpha,r}(t)|/t\ \{\log(k/t)\}^{1-\beta}$ is integrable L over $(0, \pi)$, then the r-th derived series of the conjugate series of the Fourier series of $f(t)$ at $t = x$ is summable $|R, e(\omega), \alpha + \delta|$ for any integral $\alpha \geqslant r$ and $\delta > 0$.*

In all the above theorems it has been assumed that

$$e(\omega) = \exp\ (\log \omega)^{1+\beta/\alpha}$$

11. On the summability of series associated with a Fourier series

(Kumari) Pramila Srivastava, Allahabad.

1. Let $f(t)$ be a periodic function with period 2π and integrable (L) over $(-\pi, \pi)$ and let the Fourier series of $f(t)$ be

$$f(t) \sim \tfrac{1}{2}a_0 + \sum_{n=1}^{\infty} (a_n \cos nt + b_n \sin nt).$$

$$= \sum_{n=0}^{\infty} A_n(t).$$

We write

$$\phi(t) = \{f(x+t) + f(x-t)\}/2,$$

and suppose throughout that $t > 0$.

2. A sequence $\{\lambda_n\}$ of positive steadily increasing numbers, tending to infinity with n, determines Riesz means $C_\lambda^k(x)$ of order k type λ, for an infinite series Σc_n, the means being given by the equation

$$C_\lambda^k(x) = \sum_{\lambda_n < x} (1 - \lambda_n/x)^k c_n, \ k \geqslant 0.$$

If $C_\lambda^k(x)$ is bounded as $x \to \infty$, the series c_n is said to be bounded (R, λ, k). If $C_\lambda^k(x)$ is of bounded variation in (h, ∞), Σc_n is said to be absolutely summable (R, λ, k), or summable $|R, \lambda, k|$.

3. In this paper we prove the following theorems:

Theorem 1. *If the Fourier series* $\Sigma A_n(t)$ *is bounded* $(R, \log n, K)$, *for some* k, *at* $t = x$, *and the sequence* $\{nA_n(x)/(\log n)^{1-\varepsilon}\}$, $\varepsilon > 0$, *is of bounded variation, then the series* $\sum_{n=2}^{\infty} A_n(x)/(\log n)^{\varepsilon}$ *is absolutely convergent.*

Theorem 2. *If*

$$\varphi_\alpha(t) = O(1),$$

then the condition that the sequence $\{nA_n(x)/(\log n)^{\Delta}\}$, $1 > \Delta > 0$, *is of bounded variation is sufficient for the absolute convergence of the series* $\sum_{n=2}^{\infty} A_n(x)/\log n$.

Theorem 3. *The* $|R, \lambda_n, 1|$ *summability of the series* $\Sigma A_n(t)\, l_n$ *at* $t = x$, *is a local property, where* $l_n = \varphi(\lambda_n)$ *and* $\varphi(n)$ *is a convex function of* n *such that* $\Sigma n^{-1} \phi(n)$ *is convergent. More precisely, if*

$$\int_0^t |\varphi(u)| \, du = O\{t / (\log 1/t)^{a}\}, \quad a > \tfrac{1}{2},$$

then $\Sigma A_n(t) l_{n,\varepsilon}$, *at* $t = x$, *is summable* $|R, \lambda_n, 1|$, *where*

λ_n	$\exp(n^{\Delta})$	$\exp(\log n)^{\Delta}$	$\exp(\log\log n)^{\Delta}$
$l_{n,\varepsilon}$	$1/n^{\Delta}\{\log(n+1)\}^{1+\varepsilon}$	$1/\{\log(n+1)\}^{\Delta+\varepsilon}$	$1/\{\log\log(n+1)^{\Delta+\varepsilon}$

and $\Delta > 0$, $\varepsilon > 0$.

The first two theorems of this paper generalize a result due to Mohanty and Misra (Tohoku Math. Jour., 1954; 3(i)) and the last one improves upon a theorem, established, recently by Matsumoto (Tohoku Math. Jour., 1956; Theorem 2).

12. On summability Factors

(Kumari) PRAMILA SRIVASTAVA, Allahabad.

1. Given the improper Stieltjes integral of $f(x)$, with respect to $\alpha(x)$, in the infinite interval (a, ∞), *viz.*,

$$(1) \qquad \int_a^{\infty} f(x)\, d\alpha(x) = \lim_{R \to \infty} \int^{R} f(x)\, d\alpha(x), \qquad \ldots (1)$$

its (C, k) mean is defined by the equation

$$C_k(\omega) = \int_a^{\omega} (1 - x/\omega)^k f(x)\, d\alpha(x), \quad k > -1.$$

The integral (1) is said to be summable $|C, k|$ if $C_k(\omega)$ is of bounded variation in (h, ∞), where h may be any finite positive number. If

$$\int_h^{\omega} |C_{k-1}(x)| dx = O(\omega), \; k > 0,$$

we say that the integral is bounded $[C, k]$. Further, if the integral (1) is bounded and

$$\int_h^{\omega} x |f(x)\, d\alpha(x)| = O(\omega),$$

then it is said to be bounded $[C, 0]$.

2. We prove :

Theorem 1. *If* $\lambda \geqslant 0$ *and*

$$\int^{\infty} d\,\alpha(x) = O(1) \quad [C, \lambda],$$

then
$$\int^{\infty} k(x)\ d\,\alpha(x) \text{ is summable } |C, \lambda|, \text{ where}$$

(*i*) $\underset{+}{\bar{k}}(t)$ *is a continuous function,*

(*ii*) $\int^{\infty} |k(t)|\ t^{-1}\ dt < \infty,$

(*iii*) $\int^{\infty} t^{[\lambda]+1} |\ dk^{([\lambda]+1)}(t)| < \infty,$

where $[\lambda]$ *is the greatest integer less than* λ, *and in case of non integral* λ, *also,*

(*iv*) $|k'(_{+}t)|$ *is a monotonic non increasing function of* t.

Theorem 2. *If* $\lambda \geqslant 0$ *and*

$$\int^{\infty} d\,\alpha(x) = O\{\chi(x)\}\ [C, \lambda],$$

where $\chi(x) \rightarrow \infty$, *as* $x \rightarrow \infty$, *and* $\chi'(t) = O\ \{\chi(t)\,t^{-1}\}$, *then*

$$\int^{\infty} k(x)\ d\alpha(x)$$

is summable $|C, \lambda|$, *where*

(*i*) $k(t)$ *is a continuous function,*

(*ii*) $\int^{\infty} t^{-1}\ |k(t)|\,|\chi(t)|\ dt < \infty$

(*iii*) $\int^{\infty} [t^{[\ ]+1}\ |\chi(t)\ \ dk^{([\lambda]+1)}(t)| < \infty$

and when is not an integer , also

(*iv*) $|k'(t)|$ *is a monotonic non increasing function of* t.

From these we deduce the following theorems for series.

Theorem 3. *If* Σa_n *is bounded and* $|R, \lambda, k]$ *and the sequence* $\{\phi(n)\}$ *satisfies the following conditions*

(*i*) $\Sigma n^{-1} |\phi(n)| < \infty,$

(*ii*) $\Sigma n^{1+h} |\Delta^{h+2}\phi(n)| < \infty,$

where h is the greatest integer less than k, and when k is non integral, also $|\Delta\phi(n)|$ *is non increasing, then the series* $\Sigma a_n \phi(\lambda_n)$ *is summable* $|R, \lambda, k|$, *for* $k \geqslant 0$.

Theorem 4. *If*

$$\Sigma a_n = O\{\chi(n)\}\ [R, \lambda, k],$$

where $\chi(n) \rightarrow \infty$ *with n and* $\Delta\chi(n) = O\{\chi(n)\,.\,n^{-1}\}$, *and the sequence* $\{\phi(n)\}$ *is such that*

(*i*) $\Sigma n^{-1} |\phi(n)\chi(n)| < \infty,$

(*ii*) $\Sigma n^{1+h} |\chi(n)\Delta^{h+2}(n)| < \infty,$

and when k is non integral $|\Delta\phi(n)|$ *is non increasing, then the series* $\Sigma a_n \phi(\lambda_n)$ *is summable* $|R, \lambda, k|$, $k > 0$.

Theorem 5. *If Σa_n is bounded $[R, \lambda, k]$, then $\Sigma a_n \lambda_n^{-k-t}$, $t > 0$, is summable $|R, \mu, k|$, where $\mu_n = \exp(\lambda_n)$. The factor $(\lambda_n)^{-k-t}$ may also be replaced by $\phi(\lambda_n)(\lambda_n)^{-k}$, where the sequence $\{\phi(n)\}$ satisfies the conditions of the Theorem 3.*

In case $\phi(n)$ is an L-function the conditions on $\phi(n)$ in the preceding theorems 3 and 5 reduce to the single contition of convergence of $\Sigma n^{-1}\phi(n)$. Further if $\chi(n)$ be also supposed to be an L-function, then the conditions of Theorem 4 reduce to the convergence of $\Sigma n^{-1}\chi(n)\phi(n)$.

13. A note on a-points of an entire function

Pt. Shankar Hari Dwivedi, Aligarh.

Let $n(r, a)$ denote the number of a-points of $f(z)$ and $N(r, a)$

$$= \int_0^r \frac{n(t, a)}{t}\,dt. \quad \text{Also let} \lim_{r \to \infty} \begin{matrix}\text{Sup}\\ \text{Inf}\end{matrix} \frac{\log n(r, a)}{\log r} = \begin{matrix}\rho_1\\ \lambda_1\end{matrix}$$

We prove in this note

Theorem 1.

$$\liminf_{r \to \infty} \frac{N(r, a)}{n(r, a)} \leqslant \frac{1}{\rho_1} \leqslant \frac{1}{\lambda_1} \leqslant \limsup_{r \to \infty} \frac{N(r, a)}{n(r, a)}$$

Theorem 2.

$$If\ \frac{N(r, a)}{\rho_r(r)} \to 0, \text{ then } \lim\sup \frac{n(r, x)}{(r, x)} \geqslant \rho \text{ for all } x \neq a$$

Theorem 3.

$$If\ \frac{N(r, a)}{\log M(r, f)} \to 0, \text{ then } \frac{N(r, x)}{\log M(r, f)} \to 0 \text{ for all } x \neq a$$

Theorem 4. *If a is e.v.B, then*

$$\text{(a)} \quad \lim_{r \to \infty} \frac{n(r, x)}{N(r, x)} \phi(r) = \infty \text{ for all } x \neq a, \phi(r) \to \infty$$

$$\text{(b)} \quad \lim \frac{N(r, x)}{\log M(r, f)} \phi(r) = \infty \text{ for all } x \neq a, \phi(r) \to \infty$$

14. On the means of entire functions

Pt. Shankar Hari Dwivedi, (Aligarh).

Let $f(z)$ be an entire function and let

$$M_1(r) = \left\{ \tfrac{1}{2}n \int_0^{2\pi} 2\pi\, |f(re^{i\theta})|\, p\, d\theta \right\}^{\frac{1}{p}}$$

$$m(r) = \min_{|z|=r} |f(re^{i\theta})|$$

$$M(r) = \operatorname{Max}_{|z|=r} |f(re^{i\theta})|$$

$$N(r) = \int_0^r \frac{n(t)}{t}\,dt \quad \text{where } n(t) \text{ is the number of zeroes of } f(s)$$

$$A(r) = \operatorname{Max}_{|z|=r} Re\, |(f(z)|$$

We prove here the following theorems :

Theorem 1. $M_p(r) \leqslant M(r) \leqslant \left(\frac{R+r}{R-r}\right)^{\frac{1}{p}} M_p(R)$

Theorem 2. $\log m(r) \leqslant N(r) \leqslant \log M_p(r)$

Theorem 3. $M_p(r) \leqslant A(r) \leqslant M(r)$

Theorem 4. $\log M_p(r)$ *is a convex function of log* r.

15. On Proximate order of an entire function

PT. SHANKAR HARI DWEVEDI, Aligarh.

Let $\rho(r)$ be a proximate order B and $P(z)$ be a canonical product of genus p. We prove the following theorems.

Theorom 1. *If* $N(r) \sim \lambda r^{\rho(r)}$ *as* $r \to \infty$, $\lambda > 0$, then

$$|\operatorname{Sin} \pi(\rho - p) \log P(re^{i\theta}) - \lambda\pi r^{\rho(r)} e^{i\theta}| < \varepsilon r^{(\rho r)}$$

for every $\varepsilon > 0$, $r > r_\cdot = r_\cdot(\varepsilon)$, $N(r, a) = \int_0^r \frac{n(t, a)}{t}\,dt$. *where* $n(r, a)$ *is the number of a-points.*

Theorom 2. *If* $f(z)$ *is of order* $\rho < 1$ *and if* $N(u) \sim \lambda u^\rho$, *then* $\log f(u) \sim u^\rho \pi\lambda \operatorname{cosec} \pi\rho$. *More generally* $\log f(re^{i\theta}) \sim r^\rho e^{i\theta\rho}\, \pi\lambda \operatorname{cosec} \pi\rho$ *for any fixed* θ *in* $(-\pi, \pi)$, $\log f(z)$ *denoting the branch which is real on positive real axis.*

16. On distribution of values of Meromorphic Functions of finite order

S. M. SHAH and S. K. SINGH, Aligarh.

In this paper we prove the following theorem :

Let $f(z)$ be a meromorphic function of finite non-zero order ρ and let $\rho(r)$ be a proximate order for $T(r) = T(r, f)$, Then

$$\limsup_{r \to \infty} \left\{ \frac{\sum_{i=1}^{3} n(r, a_i)}{r^{\rho(r)}} \right\} \geqslant \rho$$

$$(a_1 \neq a_2 \neq a_3,\ 0 \leqslant |a_i| \leqslant \infty).$$

We also consider the exceptional values B, E and N and discuss whether if a be an exceptional value B (E or N) then $n(r, a) = 0\,(r^{\rho(r)})$ and prove

If a is e.v. B or E then $n\,(r, a) = 0\,(r^{\rho(r)})$ but the converse is not true.

We also constract a function to show that $n(r, a) = 0(r^{\rho(r)})$ but a is neither an e.v. B nor e.v. E.

17. Stress distribution in an aeolotropic elliptic disk compressed along the major axis

D. N. MITRA, Kharagpur.

The elliptic disk is of aeolotropic material having two directions of symmetry at right angles in the plane of the plate H. Okubo (1952) has solved the problem for a circular disk. Curvillinear coordinates are used to find the stress components which are expressed by two functions. Each of these functions is expressed as infinite series of which the constants associated with each term are finally determined from a system of algebraic equations, obtained from the satisfaction of boundary stress conditions.

18. Stresses due to concentrated force in the plane of a parabolic plate with stress free boundary.

MADAN MOHAN GAIND, Kharagpur.

In this paper the method of complex function theory has been employed to solve a two dimensional problem for an elastic parabolic plate with stress free boundary under the effect of a concentrated force acting at any point of the plate when the stresses and rotation vanish at infinity. The method leads to the solution of Hilbert problem.

19. Application of the derivative of Dirac's delta function in a problem of a light beam acted on by a concentrated force and a concentrated couple

S. R. MITTAL and G. R. VERMA, Pilani.

To illustrate the use of the derivative of a delta function, a simple problem is discussed in this paper. The problem is concerned with a light beam which is clamped at both ends and which is acted on by a concentrated transverse load at a distance a from one end and a concentrated couple of bending moment M at a distance b from the same end.

20. Stress distributions in thin plates around holes having curvilinear boundaries

A. M. SENGUPTA, Ranchi.

In this paper stresses in a thin plate around a hole having a regular curvilinear polygonal boundary, in general, under no body forces, the plate being otherwise infinite and subject to a uniform shear 'S' parallel to X and Y axes at large distances from the hole, are found out to illustrate that this type of problems can be solved directly by the method developed by the author (Sengupta 1957, Z. angew. Math. Mech. Bd. 37 Nr. 1/2p 27, 1957) for solving problems of steady rotation of certain thin elastic plates about normal axes.

21. Displacement and stresses due to a prescribed twist on the surface of a spheroidal cavity.

SAKTIKANTA CHAKRABORTY, Calcutta.

The displacement and stresses produced by a timeperiodic twist acting on the inner surface of a spheroidal cavity situated inside an elastic medium have been obtained in terms of series of spheroidal functions. Two cases have been considered, accordingly as the cavity is a prolate or an oblate spheroid.

22. Torsion of a large thick plate with rigidity varying linearly with depth and rigidity fixed at one face

S. B. DUTT, Calcutta.

Investigations on torsion of a Semi-infinite elastic body by a shear stress prescribed within a circular area were carried out by Reissner and Sagoci, Sneddon and Yi-Yuan Yu. They all obtained explicit solutions by introducing different methods. In the present paper, we have discussed similar problem of torsion of a large thick plate (which refers to one of finite thickness, but otherwise unlimited in extent) with rigidity varying linearly with depth and rigidly fixed at one face. To find the displacement component and stress component for the above problem, the solution of the differential equation for stress function has been obtained on using Fourier-Bessel Integral.

The analysis has further been extended to the torsion of a plate by two shearing forces prescribed at the bounding surfaces and expressions for stresses on the bounding planes of the thick plate have been obtained on using the same Fourier-Bessel Integral.

23. Stress concentrations around a small spherical inclusion on the axis of a circular cylinder of transversely isotropic material under torsion.

P. P. CHATTARJI, Calcutta.

The paper is concerned with the problem of a rigid spherical inclusion on the axis of a circular cylinder under torsion, the material of the cylinder being transversely isotropic. The results deduced involve Legendre's associated functions of the second kind of which the values can be easily obtained from the tables.

24. Deformation of spherical bodies of fluid-saturated elastic material—I

GUNADHAR PARIA, Kharagpur.

The theory of deformation of fluid-saturated elastic material has been formulated for a spherically isotropic medium. The fundamental equations for the isotropic medium have been deduced as the particular case. The displacement in a spherical shell of isotropic material under internal and external pressures has been found as an illustration. When the thickness of the shell is small compared with the internal radius, the displacement consists of two parts, a steady state part and a transient part. The transient part relaxes just after the application of the pressures.

25. Prandtl-Meyer's expansion in viscous flow

AJIT KUMAR ROY, Bangalore.

In the usual Prandtl-Meyer's expansion about a sharp corner in the two dimensional supersonic, non-viscous flow, the disturbance in the form of the expansion waves will start from the corner point, the effect of which (consistent with the notion of the supersonic flow) will be felt downstream the corner point. But as soon as the viscosity of the flow is considered, the corner lies embedded in the subsonic boundary layer developed along the plane surface protruding the sharp corner, due to which the effect will be felt (because of the characteristic property of the subsonic flow) immediately upstream the corner point.

Starting with this basic idea, the present problem has been dealtwith by solving the boundary layer equations about the corner point; but the boundary layer approximations will not be valid unless the sharp point is rounded (and this rounding of the corner can be done because the effect of viscosity in the boundary layer is as if to round off the corner so as to have a finite velocity at the corner point) in which case, there will be theoretically no difference in the total pressure change in the direction of the flow about the corner.

26. The stability of certain non-Newtonian flows between two rotating cylinders

M. K. JAIN, Kharagpur.

The stability of certan non-Newtonian flows between two rotating cylinders has been discussed by taking the modified stress-strain law

$$t^i_j = -p\delta^i_j + 2\mu \, d^i_j + 4\mu_c \, d^i_\alpha \, d^\alpha_j , \quad 2d_{ij} = u_{i,j} + u_{j,i}.$$

Chandrasekhar's variational procedure for solving the underlying characteristics value problem and for determining the critical Taylor number has been given.

It is found that the effect of cross-viscous forces is to inhibit the onset of instability, the inhibiting effect depends on a non-dimensional number Q which is proportional to the coefficient of cross-viscosity.

27. Slow Homologous Contraction of a Star with a Special Type of Subatomic Energy Generation

G. BANDYOPADHYAY, Kharagpur.

A star having subatomic energy generation having two terms (one obeying suitable power law and the other proportional to temperature) can undergo slow homologous contraction.

28. The Pleiades

P. C. CHAUDHURI, Pilani.

The Convergency of the Pleiades had been investigated by Plummer, Trumpler, Rasmuson, Alden and Boss. None of them except Rasmuson, removed the *K*-term which is characteristic of the *B*-type stars from the observed radial velocities. However, the convergent points obtained by these investigators are within a few degrees of the solar motion. In view of this as well as other reasons Hertzsprung thought that the motion of the pleiades might be reflected solar motion. But he could not reconcile the colour-brightness relationship of the stars belonging to the Pleiades and consequently suggested that the physical Pleiades form a moving cluster system.

The present investigation has been undertaken with a view to obtain a reliable convergent point for the stars of this group from the available observational materials and then to study the kinematical characteristics of the physical members, such as position angles, radial velocities, parallaxes and absolute magnitudes in order to ascertain whether the Pleiades form a moving cluster system or reveal the reflected solar motion alone.

We have utilized 44 stars, 26 stars from the G.C. and 18 from the Catalogue[1] of parallaxes brighter than the ninth magnitude stars and obtained a convergent point ($A = 6^h\ 21^m.8$, $D = -47^\circ.2$) for the epoch 1950 A.D. On this basis the kinematical characteristics, as mentioned before, have been investigated. Accordingly, it is concluded that 41 stars of our list belong to the Physical Pleiades forming a moving cluster. It has also been found that there is deviation in the absolute magnitude of the stars of certain spectral types from the main branch of the Hertzsprung-Russell diagram, most probably due to the possibility of obscuration in the Pleiades. An attempt has been made to estimate roughly the obscuration-effect for the stars concerned.

1. Schlesinger.

29. Diffraction of a wave based on ray optics by a rigid circular cylinder

N. BALASUBRAMANIAN, Cochin.

Diffraction of a wave has been treated on the basis of Fermat's principle. This is an extension of ray optics which accounts for diffraction by introducing rays called diffracted rays. A simple formula has been derived in the case of a rigid circular cylinder, giving the diffracted field. Extension of the method to general bodies is in progress.

30. A matrix method of reduction of the General Lorentz transformation

N. N. GHOSH, , Santiniketan.

This paper is concerned with the reduction of the General Lorentz Transformation in 4-space. Starting with the Minkowski's representation, the complex orthogonal matrix A associated with it is first taken in a form e^{Ω}, where Ω is a certain Skew-sym-

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metric complex matrix of rank 4. The transition from A to Ω is effected by an auxiliary matrix, $(A-\bar{A})/2$. Making use of the characteristic equation of Ω. e^{Ω} 4 is then reduced to the form

$$E+\sum_{e=1} f_e \Omega\,,$$

where the four functions f can be determined. Introducing two new matrices Γ_2 and Γ_4 such that $\Gamma_2+\Gamma_4=\Omega$ and $\Gamma_2\Gamma_4=0$, the above breaks up into a pair of commutative orthogonal factor-matrices, representing a pair of plane rotations. A resolution by means of a pair of non-commutative factor-matrices derived from Spinor Theory is also noted in this connection.

SECTION OF STATISTICS

PRESIDENT : DR. K. KISHEN, M.A., Ph.D.

Abstracts

Distribution Theory

1. Selection of a Subset Superior, Inferior or Equivalent to a Control.

K. C. SEAL, Calcutta.

Given a set of continuous populations which are assumed to be identical except for their unknown location parameters and whose other parameters, if not known, are eliminable by means of Studentization, some optimum decision rules possessing many desirable properties are suggested for selection of a subset of populations which is likely to include any population-superior, inferior or equivalent to some specified standard population of the same kind. In this case, two distinct types of problems usually arise in practice. These problems, which may appropriately be designated as (i) one-sided and (ii) two-sided problems, are discussed separately and the suggested decision procedures are illustrated with some hydrological and industrial problems.

2. A Characterization of the Normal Distribution

J. N. K. RAO, Dehra Dun.

Using characteristic functions, Lukacs has shown that a necessary and sufficient condition for the independence of the sample mean and variance is that the parent population be normal. Geisser has derived a similar theorem concerning the independence of sample mean and first order mean square successive difference. In this paper, we derive a general theorem of which Lukacs's and Geisser's results are particular cases, showing that a necessary and sufficient condition for the independence of sample mean and sum of squares of linear contrasts among the observations is that the parent population be normal. We extend the result to the p-variate case of which Lukacs's result concerning the independence of sample mean vector and variance-covariance matrix is a particular case. In proving the necessary condition, we extend Daly's result that sample mean is independent of any function which is invariant under translation, if $f(x)$ has normal density, to the p-variate case.

Estimation and Testing of Hypotheses

3. Further Contributions to "Approximating by a Power of χ^2"

Y. S. SATHE and A. R. KAMAT, Poona.

In previous papers submitted to the last two sessions of the Science Congress, we had dealt with approximating the distributions of the mean square successive difference and of the mean successive difference by a power of chi-square. In the present paper, we make further contributions to this procedure. The same type of approximation is used for the distributions of two statistics which are based on second differences, namely, $\delta_2^2 = (n-2)^{-1}\ \Sigma(x_i-2x_{i+1}+x_{i+2})^2$ and $d_2 = (n-2)^{-1}\ \Sigma\,|x_i-2x_{i+1}+x_{i+2}|$. Our results show that over a wide range of sample size the same power of chi-square can be used for each of these statistics. This use of same power of chi-square makes it possible to compare two different estimates of variability about the slow moving trend in the mean by the use of tables of percentage points of F-ratio.

In this paper, we round off the discussion of this approximating procedure by indicating its adequacy and usefulness as compared with other approximating procedures.

4. Use of Evaluation Control Chart in Scholastic Tests.

P. K. Bose and S. B. Chaudhuri, Calcutta.

In scholastic tests, there are two important sources of variation, namely, (i) Variation due to subject, and (ii) Variation due to examiners, which affect to a considerable extent the final ranking of the candidates. The first part of the problem has already been solved by Bose and Chaudhuri (1954). This paper attempts to solve the second part of the problem. An Evaluation Control Chart has been constructed to examine whether scores given by the different examiners are statistically controlled. If they are not, defective scripts have to be reexamined before any ranking is made.

5. Goodness of fit Test for a simple Additive Moving Average Scheme.

Mr. K. N. Venkataraman, and Dr. D. V. Rajalakshman, Madras.

Consider a stochastic scheme $\{X_t\}$ such that $\{X_t\} = \{\overset{(1)}{X_t}\} + \ldots + \{\overset{(m)}{X_t}\}$ where $\{\overset{(i)}{X_t}\}$ (for $i = 1$ to m) is each a stationary process of the moving average type of order h_i and $\{\overset{(i)}{X_t}\}$ and $\{\overset{(j)}{X_t}\}$ for $i \neq j$ are completely independent in the sense that any two vector variables derived one of each are independently distributed. It has been proved that for every scheme of the type $\{X_t\}$ there exists a corresponding moving average scheme $\{\overset{(o)}{X_t}\}$ of the order $h_o = \max.\ h_i$ ($i = 1$ to m). Though some of the properties of the scheme are similar to those of the corresponding moving average scheme, it is noted that the model is distinctly different, particularly when the covariance of sampling auto-correlations are considered.

The test procedure suggested by Wold to study goodness of fit of an observatorial record of time series to $\{\overset{(o)}{X_t}\}$ when applied leads to the same function both for $\{\overset{(o)}{X_t}\}$ and $\{X_t\}$. So it is not possible to distinguish which of the two schemes is suitable for a given realisation by using the available goodness of fit tests.

Taking into consideration the moments of the 2nd and 4th order of the error distributions associated with the schemes, a goodness of fit test has been developed for the scheme $\{X_t\}$. It is also observed that the 4th central moment of the error distribution associated with $\{\overset{(o)}{X_t}\}$ is not related to the corresponding moments of the error distributions of $\{\overset{(i)}{X_t}\}$.

If the moments of the error distribution are not given and have to be estimated from the observational data, it has been shown that under fairly general conditions the test procedure is valid asymptotically.

Design of Experiments

6. On Reinforced Incomplete Block Designs.

M. N. DAS, New Delhi.

An incomplete block design obtainable from any available incomplete block design by reinforcing it with some extra treatments and extra blocks has been defined. Both inter- and intra-block methods of analysis of the design have been worked out. It is always possible to get such designs, whatever the number of treatments, keeping the total number of experimental plots as low as desired. The design has provision of two block sizes so that some wastage in experiments with animals as experimental units can be avoided by including litters of two different sizes in the same experiment.

7. On Problems of Analysis of Experiments having Missing or Mixed up Plots

M. N. DAS and P. N. BHARGAVA, New Delhi.

An investigation of the inter-relationship among the different methods of analysis of experiments having missing or mixed up plots has been made. The rationale behind the technique of covariance analysis of such problems has been discussed. Application of the technique of covariance analysis has been extended to cover cases of non-orthogonal designs, namely, confounded and incomplete block designs in the case of both missing and mixed-up plots. The technique has been extended in the case of mixed-up total to cover more than one group of mixed up totals. A more convenient set of pseudo-variates than what has been given by Nair for solving problems of mixed-up total has been obtained,

8. Row Balance P.B.I.B. Design.

N. C. GIRI, New Delhi.

A Youden square is an arrangement of the blocks of a balanced incomplete block design where the position within the blocks can be regarded as rows. According to Smith and Hartley, in the case where the number of blocks is an integral multiple of the number of treatments, the rows contribute systematic effects in the observations, and it is possible to eliminate the row variability along with the block variability in a manner similar to that employed in a Latin square. Recently, Taylor (1957) has shown that it is also possible to eliminate the row variability even when $b \neq mv$. In this paper, an attempt has been made to develop similar types of arrangements in the case of P.B.I.B. designs so that the rows also contribute systematic effects in the observations. The method of analysis of this type of arrangement with and without recovery of inter-block information is also given,

Theory of Sampling

9. A Single Sampling Plan for Correlated Variables with a Single-sided Specification Limit.

K. C. SEAL, Calcutta.

An economic single sampling plan for a variable having a single-sided specification limit whose direct measurement is very expensive or destructive is suggested in this paper. Assuming existence of at least one correlated auxiliary variable whose measurement is not so expensive and of a known dispersion matrix of these variables, the suggested plan is shown to have easy practical application. Further, the choice of only one auxiliary inexpensive variable highly correlated with the main variable is shown to be optimum in most of the practical situations.

10. Double Ratio Estimate in Forest Surveys.

J. N. K. RAO, Dehra Dun.

Estimation of the ratio of total number of trees of Class I to total number of trees of Class II and of the total number of trees of a particular diameter class are important problems in forest surveys, since they enable us to prescribe the annual yields by using the safeguarding formula for selection felling series given by Smythies.

A double ratio estimate to estimate the ratio of total number of Class I to Class II trees is used by utilising the previous complete enumeration data and its efficiency is found out for the enumeration data of Kalagarh Forest Division, U.P. Double sampling is used to estimate the mean number of trees of the lower diameter class, utilising the supplementary information of the number of trees of the next higher diameter class of the present enumeration and the past complete enumeration data, and its efficiency over other estimates of the mean number of trees of the lower diameter class is found out. Also estimation of the mean number of trees per acre of the lower diameter class is considered, using double sampling and utilising the areas of the compartments or topographical sections, and a problem regarding efficiency of stratification for the double ratio estimate is illustrated on the enumeration data of Sal forests of Haldwani Division, U.P.

11. Optimum Allocation with Double Sampling for Stratification.

M. V. JAMBUNATHAN, Mysore.

Continuing further the author's study of the problem of optimum allocation under double sampling, this paper points out how the optimum allocation conditions would be modified when $S_i^2 / a_i > S_b^2 / b$, where S_i^2 is the variance of the principal character y in stratum i, S_b^2 is the between-strata variance, b, the unit cost of the preliminary sample and a_i, the cost of enumerating an element in the sub-sample in stratum i. The result is then applied to the problem of non-response in sample surveys, and it is shown that if $S_1^2 / a_1 < S_b^2 / b$, the subscript 1 referring to the response group, it will add to the gain in precision to sample both the non-response group and the response group.

This means that, paradoxical as it may appear, it is an advantage to discard a fraction of the data already collected from the response group. A concrete example with numerical data is furnished to illustrate the gain in this method over the usual method of subsampling the non-response group only. For the same level of precision, the costs are as follows :

Unstratified random sampling :	Rs. 740
Usual method :	Rs. 680
Improved Method suggested :	Rs. 645

Genetical Statistics

12. Estimation of Heterozygosity with and without Selection in any Generation for Varying Proportions of Self-and Cross-fertilization.

S. N. Sen, Barrackpore.

Among plants, there are species with different proportions of self- and cross-fertilization and the approach to 100 per cent self or cross is not complete. The crops like paddy, wheat, peas, cotton, jute, sabdariffa, etc., are self-fertilization, but reproduction occurs in varying proportions by natural cross-fertilization. The estimation of the amount of heterozygosity at any generation in such crops will help the breeder in the successful task of hybridization.

A. *Selection* (complete elimination of the recessives) :

Let y = the proportion of heterozygosity at the parental stage,
p = the gene frequency ($p+q = 1$),
a = the proportion of cross fertilization,
and $2b$ = " " self-fertilization.

Then, the proportion of heterozygosity at the n-th generation is given by

$$Yn = \frac{a \,.\, 2q(1+\overline{n-1} \,.\, q)}{(1+nq)} + \frac{ab \,.\, 2q(1+\overline{n-2} \,.\, q)}{(1+\overline{n-1} \,.\, q)^2} + \ldots + \frac{ab^{n-1}2q}{(1+q)^2} + yb^n$$

$$= a \,.\, 2q \,.\, \sum_{i=1}^{n} \frac{(1+\overline{i-1} \,.\, q)b^{n-i}}{(1+iq)^2} + yb^n.$$

When $a = 1$, $y_n = \frac{2q(1+\overline{n-1} \,.\, q)}{(1+nq)^2}$ for all values of y;

and when $a = 0$, $Yn = yb^n$.

The limiting value of Yn for large n is zero.

B. *No Selection* :

Using the same notation as before, the proportion of heterozygosity is represented by

$$Y_n = 2pq\left[\frac{a(1-b^n)}{1-b}\right] + yb^n$$

This result in case of no selection has also been reported by Hadley in a different way. Garber has also obtained another formula in case of no selection but that is more complex and unwieldy.

When $a = 0$, $Y_n = yb^n$.

If $y = 1$ and $b = 0.5$, $Y_n = (\frac{1}{2})^n$,

which is the most familiar result due to Mendel.

When $a = 1$, $Y_n = 2pq$, *i.e.*, the proportion of heterozygotes remains stabilised at a fixed value which is independent of the generation effect.

Exhaustive tables for estimating the proportion of heterozygotes (Y_n) for varying values of y, p, a and n have been worked out in both the cases, *viz.*, (a) where there is selection (by completely eliminating the recessive only), and (b) where there is no selection. Various interesting results may be obtained from a study of these tables.

Economic Statistics

13. Factors Affecting Investment in Indian Industry.

V. K. Sastry and V.V. Prasadarao, Bombay

This paper is concerned with an empirical study of the factors affecting investment in private industrial sectors in India. The study is based on investment in the year 1954 relating to a sample of individual firms in six selected industries, *viz.*, cotton textiles, sugar, paper, basic industrial chemicals, engineering and electricity. Multiple regression technique has been used to examine the effect of different factors, such as the size of the firm, sales and profits (current as well as lagged) and holdings of current assets, on the investment in fixed assets. It has been found that sales or profits with a lag of one year are by far the most signicfiant factors influencing investment outlays of a firm.

SECTION OF PHYSICS

PRESIDENT : S. L. MALURKAR

General Physics

1. Unlike Molecular Interactions and Properties of Gas Mixtures.

K. P. SRIVASTAVA, Calcutta,

Recently we have developed a set of semi-empirical combination rules which may be utilised to calculate the intermolecular potentials for unlike pairs of molecules from the known potentials for like pairs on the modified Buckingham exp-six model. It is, therefore, necessary to see how far these combination rules can reproduce the transport properties of binary gaseous mixtures over large ranges of temperature and concentration. With this end in view, various transport properties, such as thermal diffusion, inter-diffusion, thrmal conductivity and viscosity, have been calculated for a large number of binary mixtures and the computed values compared with the experimental data. It is found that the agreement between the theory and experiment is quite satisfactory. It is concluded that this set of combination rules can be used with success to predict the transport properties of gaseous mixtures within the limits of experimental error.

2. The Heat of Mixing of He^3 and He^4 Solutions.

S. K. TRIKHA, Delhi.

Recently a theory of He^3 and He^4 solutions has been developed by Trikha and Nanda . On the basis of the theory we have calculated the heat of mixing of He^3 and He^4 solutions for various He^3 concentrations varying from 0.58 to 4.00 per cent by using the linear and quadratic expressions for G_4.

We have also derived the heat of mixing from the vapour pressure data of Sommers and of Daunt and Tseng for solutions of He^3 in He^4. The values of the heats of mixing derived from the vapour pressure data are found to be in fairly good agreement with the corresponding values calculated on the basis of the theory.

3. Direct Interaction Theory of Inelastic Scattering.

M. K. BANERJEE, Calcutta.

The direct interaction theory of nucleus on nuclei is developed and the necessity of considering distorted waves pointed out. The scattering formula has been worked out with the distorted waves and some of its features discussed.

4. On Core-to-particle Interaction from Classical point of view.

S. MUKHERJEE AND A. GUPTA

The treatment of the extra-core particle in the semi-rigid model of nucleus, in a core plus one particle system, in a sense justifies the form of the interaction hamiltonian used, in such cases, by A Bhor in his collective model of nucleus.

5. Some calculations of improved overlap intergrals of BeO ($B'\Sigma - X'\Sigma$) system under perturbation theory.

N. SREEDHARA MURTHY AND N. R. TAWDE, Dharwar.

The overlap integrals of the bands of BeO ($B'\Sigma - X'\Sigma$) system are calculated by improved approximate analytic method given by Fraser and Jarmain, and Fraser. They have also been calculated by the method of direct numerical integration, involving Morse oscillator by extending the author's earlier work on this aspect. Both sets of results come out in excellent agreement. A good deal of labour involved in the use of numerical integration method is saved by adopting the new analytic method. This method can be profitably used where it can be applied.

6. On Born approximations in polarisation of electrons by potental scattering.

H. BANERJEE, Kharagpur.

Polarisation dependent cross-section in the scattering of an electron by a screened Coulomb field has been calculated up to the second Born approximation. Covariant S-matrix formalism of Feynman and Dyson has been used. Expression for the azimuthal asymmetry factor δ in the intensity distribution of the finally scattered electron beam in a double scattering experiment has been derived correctly up to $(\alpha Z)^2$.

7. The influence of constant electric and magnetic fields on the spin of the particle.

D. BASU AND S. SARKAR, Calcutta.

Tolhoek has discussed the change of momentum and spin orientation of an electron beam when subjected to constant transverse and longitudinal electric and magnetic fields. He has treated the problem, according to three methods, viz., Klein Gordon's eqn., Pauli spin theory and Dirac's linear wave eqn. for an electron. The results obtained by various methods agree in nonrelativistic approximation. If we assume that the particle obeys the second order equation of the form

$$[(E-e\phi)^2-(c\,\vec{p}-e\,\vec{A})^2-m^2c^4+ehc\,\vec{\sigma}'.\vec{H}+iehc\,\vec{\alpha}.\,\vec{\varepsilon}\,]\,\psi=0 \qquad \ldots \quad (1)$$

which is obtained in the usual way of operating twice the Dirac's linear Hamiltonian, we find that the change of spin direction in the magnetic and electric fields is the same as for a particle obeying Dirac's first order equation.

8. On the nature of the gravitational field.

F. Ba HLI.

This paper puts forward an explanation of the gravitational field in terms of a Net Attractive Force (Electrical), which is nothing but the slight difference between the force of electrical attraction and the force of electrical repulsion. Coulomb's law states that the electrical forces between electric charges varies inversely as the square of the distance between them and experiments indicate that this is so and also that the attractive force is equal in magnitude to the repulsive force to within the precision of our electrical experiments. But suppose that the force of electrical attraction is stronger by one part in 10^{36} than the force of electrical repulsion. This tiny difference, which cannot be detected by the electrical experiments, can be detected by the gravitational experiments and it is shown that electrically neutral bodies will attract each other w th a Net Attractive Force (Electrical) which will be proportional to the masses of the two bodies and inversely proportional to the square of the distance between them. Also this NAF (E) theory explains the other phenomena of gravity, such as its ability, to pass through all materials and through vacuum. It is also shown why we have not been able to find a "shield" against gravity.

9. Gravitational field of isolated rotating masses.

SHRI R. V. WAGH, Poona.

It has been taken by Thirring, Bass and Pirani and others that in the case of rotating masses, the resulting gravitational field leaves the pressure isotropic. It has been shown in an earlier note that the pressure remains isotropic to a first degree of approximation. It is now shown here that the condition of isotropy is not satisfied in the general case which involves terms of second and higher orders of smallness. The line-element for this case has been taken as

$$ds^2 = -(1+\alpha)(dr^2 + r^2 d\theta^2 + r^2 \sin^2\theta d\phi^2) + (1+\alpha)^{-1} dt^2 \qquad \ldots \quad (1)$$

with $\alpha \equiv \alpha(\zeta)$ and $\xi = 1 - mr^2\omega^2 \sin^2\theta$. The solution in this case is found to be of the form, *viz.*

$$1+\alpha = \{a - b \log(1-\xi)\}^2 \qquad \ldots \quad (2)$$

giving $T_1^1 \neq T_2^2 \neq T_3^3$. The energy at $r = 0$, which is the centre of the system of rotating masses and at the time 't' is found to be equal zero.

10. Altitudes of a Simplex in Four Dimensional Space.

SAHIB RAM MANDAN, Kharagpur.

Altitudes of a triangle concur. Altitudes of a tetrahedron may or may not CONCUR depends on the tetrahedron.

The present paper is just an extension of the same in space just one dimension higher to show what shape the problem takes as we rise in spaces of higher dimensions one by one. We start with a general simplex, discuss the behaviour of its altitudes, discover a point, associated with it, where CONCUR the Normals to its prime faces at the points of trisection of the segments between their Monge points and the feet of its altitudes therein, name the same as its S-Point where also CONCUR the ten planes, perpendicular to its plane faces, through the point of trisection of the segments between their ortho-centres and the mid-points of their opposite edges. We also note that the centriod of the simplex is collinear with its S-Point and circumcentre,' and divides their join, in the ratio 2 : 3, called as its Euler Line.

Before we introduce a Semi-orthocentric simplex, develop its properties connected with its Bi-altitudes and associated Hyper-spheres leading to those of an Orthocentric one, we make note of what happens in passing on to it gradually from a general one through special ones which in themselves form three very interesting Sections of the Paper.

11. Photoconductivity of sulphur.

B. N. SRIVASTAVE, R. K. RASTOGI AND K. P. VERMA, Naini Tal.

A bridge type D. C. amplifier circuit using two 4060 electrometer tubes, has been constructed. The gm of these tubes is 28×10^{-6} amp/volts, hence a suitable galvanometer with a deflection sensitivity of (10^{-9} amp/mm) was used in combination with this arrangement, so as to read photo-currents of the order of 10^{-15} amp to 10^{-16} amp, which is approximately the order of currents involved in the photoconduction of sulphur. Lot of electromagnetic pickup troubles were observed, and were removed by properly shielding the whole apparatus. Moisture leakages due to surface film formation were eliminated by keeping silica gells and working in a dried room.

Spectral response of photoconductivity was observed using different wavelength filters and photoconduction maxima were found in the region of violet, the order of $\lambda = .43\mu$ and $\lambda = .60\mu$ in the red. A dip was observed in the spectral behaviour in the yellow region, which is perhaps due to yellow colour of sulphur. The average resistivity of sulphur is found to be of the order of 10^{16} ohms cm.

These results agree with Kurrel-meyer (1927)) but, he seems to have missed to observe the dip in the yellow region. A thorough checkup of the spectral behaviour is in progress. Variation of photoconductivity at liquid air temperature will be taken up in a short while.

12. Threshold potential for the low frequency electric discharge in air using a Maze counter.

H. D. SHARMA, Sagor.

The threshold potential V_m for the low frequency electric discharge using Maze counters has been determined for air over a range of pressure 'p' from 1 to 250 mm Hg. The $V_m - p$ curves are not linear being concave towards the pressure axis. For a given wire diameter $2r$, V_m is seen to increase as the diameter of the outer glass cylinder increases. A comparison is also made using the $rX - rp$ curves when X is the field strength at the wire surface. While those curves appear to coincide for low rp values, for higher rp values, there is appreciable difference, the values of rX for the largest tube being the least.

13. Modified cone source.

V. G. BHIDE, Nagpur.

Some of the observations of the growth patterns on SiC crystals provide an experimental evidence for the operation of a modified cone source. The Frank-Read source is only one example of a topological property of a dislocation node. In Frank and Read source, the sweeping dislocation spirals in the same plane, each revolution of the spiral causing unit slip. The slip is thus in a plane perpendicular to the crystal surface. Conversely, if the sweeping dislocation climbs as it rotates, as is envisaged in the cone source, it will produce a multiple step, but the slip step will not be in the original slip plane, but will in fact be made up of steps of atomic scale of the planes parallel to the original slip plane. A varient of this cone source is one in which the plane in which the dislocation spirals rotates about an axis, is perpendicular to the crystal surface.

14. Surface structure of dendritic growth of metal crystals

V. G. Bhide and W. G. Nafde, Nagpur.

Optical and interferometric studies of the dendrites of (A) tin grown by, (i) the action of Zn on $SnCl_2$ solution and (ii) the electrolysis of $SnCl_2$; (B) of silver grown by, (i) the action of Zn on a thin film of $AgNO_3$ and (ii) the electrolysis of $AgNO_3$; and (C) of germanium grown from undercooled melt, have been carried out. Both in the cases of tin and silver, two types of crystals viz., (i) flat dendrites with primary and secondary branches and (ii) needles with occasional branches, have been found to occur. This change in habit can be brought about by the variation of the substrate and the current density. It has been possible in the cases of tin, silver and germanium to correlate the surface features with their space lattice.

The tip of the dendrite, irrespective of the mode of growth, offers a favourable spot for nucleation and initiation of growth layers which are multimolecular.

In few cases, the silver crystals were found to grow in the form of thin platelets which are plane to within monolayers. On some of these crytals growth spirals, in accordance with the Frank's theory (1949, 1952) of crystal growth, have been observed. These growth spirals develop on the octahedral faces, and are either triangular, hexagonal or circular in outline. The step height of the spiral is estimated to be nearly 200A°. These observations show that the Burgers vector of the screw dislocations, responsible for the spirals observed on silver, is not necessarily limited to a unit lattice displacement as is generally assumed.

Technique of Apparatus and Computing Machines

1. The construction and the working of a wideline nuclear magnetic resonance (N.M.R.) spectrometer.

S. S. Dharmatti, K. J. Sundara Rao and R. Vijayaraghavan, Bombay.

A wide-line nuclear magnetic resonance Spectrometer of the Bloch type operating between 4-10 Mc/s has been constructed. With an eleven inch electromagnet system, the Spectrometer is applicable to the measurement of the magnetic moments still unknown for some nuclei, certain chemical shifts and relaxation time determinations. The details of the Spectrometer and the electromagnet system will be discussed. The results obtained so far will be presented.

2. Report on the design and construction of a large-scale digital computer.

P. V. S. Rao, Bombay.

This paper is a report on some of the more interesting aspects of the design and fabrication of the large-scale Digital Computer that is currently in progress at the Tata Institute of Fundamental Research, Bombay.

A Pilot Digital Calculator has been functioning in the Institute for nearly a year. Experience gained in the construction and operational maintenance of the pilot machine has been of very valuable help in the design of the full-scale machine.

A number of useful built-in instructions has been added to the list of the fifteen that is available in the pilot machine.

The control logic of the full-scale pilot calculator has been considerably simplified, and this is expected to make its routine maintenance appreciably easier.

A fast logical adder has been developed in the Institute to cope up with the increase in speed of the control of the new machine. Also, suitable modifications in the existing gating logic have resulted in a fast double rank shift counter which is capable of additive and subtractive counting at the same time.

The fast access memory of the machine is a three dimensional ferrite core matrix with a capacity of storing 1024 words of 40 bit length. Provisions have been made to double this capacity by the addition of another identical matrix.

Preliminary work on a magnetic drum storage is being carried on.

It is expected that the full-scale computer with the internal memory will be completed by the middle of 1958.

3. Report on the three dimensional ferrite-core magnetic memory of the T.I.F.R. calculator.

T. R. N. Rao, S. P. Srivastava, and C. V. Srinivasan, Bombay.

The three dimensional ferrite-core matrix memory of the TIFR Pilot Digital Calculator is described. The memory matrix consists of a stack of twelve digit planes (the *xy* planes) each containing a square array of 256 cores (16×16). Twelve-bit words are stored, one in each of the 256 columns along the depth of the matrix. Selection of any one of the 256 locations is done on coincident current basis by the simultaneous excitation of a suitable pair of x and y lines. The necessary drive currents are supplied by linear pulse transformers. The process of reading destroys the information stored in the location and hence it is followed by a rewriting cycle during which the information can be replaced or a new one inserted in its stead. High signal to noise ratio is obtained by amplitude discrimination of the output signal at an optimum time by sampling or strobing with a very short pulse. One complete read-write cycle takes 8 microseconds.

A brief outline is given of the larger memory that will be incorporated in the full-scale machine. This will accommodate 1024 locations, each capable of storing one 40-bit word.

4. Study of the Recording of Pulses on the Magnetic Drum for the Storage of Digital Information.

K. Bakhra, Bombay.

Experiments were carried out to study the recording of pulses on the surface of a magnetic drum to be incorporated as an auxiliary store of large capacity in the digital computer now being set up in the Tata Institute of Fundamental Research, Bombay.

To develop a suitable head for recording, reproducing and erasing operations at pulse rates up to 50KC/S or more, various types of magnetic heads made locally from μ-metal strips were studied along with a commercially available type made of Ferrite material.

Because of its simplicity, the 'return to zero' code of recording was adopted in which a pulse is represented on the drum surface by a spot magnetised to saturation in one direction surrounded by a background field magnetised to saturation in the other.

Measurements of the recording and erasing currents with which the head should be energised to give maximum signal to noise ratio were made.

This report describes the effects of air gap between the pole pieces of the head, drum velocity, pulse duration etc. on the packing density and the reproduced signal.

5. Compton Coincidence Spectrometer.

H. G. Devare and S. Jha, Bombay.

Factors giving rise to a distribution of pulses for monoenergetic rays in scintillation spectrometers are considered. A two crystal scintillation spectrometer making use of coincidence between compton recoil electron pulse in one crystal and the pulse due to the detection of the scattered γ ray in the other crystal to obtain a unique response for γ rays, is described. Limitations as regards useful energy range, resolution and efficiency are considered.

6. A New Method for the Measurement of Dielectric Constant of Powders.

G. B. Mitra, Kharagpur.

Dielectric constants of powders are generally measured by packing them between two plates and determining the change in capacity of the two plates system before and after the introduction of the powders. The results of the measurements are generally adversely affected by the uncertainties of the packing, particle size distribution, etc. The new method consists in generating an inhomogeneous static electric field in a dielectric viscous liquid medium. The powders when placed in such a field with experience an alignment along the lines of force due to the reorientation of induced and permanent dipoles in the powder. The inhomogeneity of the field gives rise to a resultant tractive force to be applied to the powder particles causing a translatory motion in them. The force acting on each particle is proportional to the difference in dielectric constants of the powder and the medium. The force is measured by determining the acceleration of the particles by observing their motion under a microscope and the mass is determined by finding its volume by the stokes law method and multiplying it by its density. The inhomogeneous field was created by keeping at the centre of a copper rod a semicylindrical copper sheet and maintaining a d.c. potential difference between them ranging between 10 to 50 KV. The electrodes were dipped in transformer oil and powders of lead nitrate were put in the field. The smaller particles moved at 15 K.V. and bigger particles at 30 K.V. The dielectric constant was found to be approximately the same as determined from single crystal data.

7. Nonlinearity in Photomultipliers and a suitable method of its removal.

B. N. Srivastava, Naini Tal.

Photomultipliers 5819, 1P28 and 931-A have been thoroughly studied from the point of view of their nonlinear behaviour at a certain stage of electron current through them. It has been found that when the electron current is increased, a marked change in the interdynode potentials takes place and after a perticular stage these potential fluctuations become erratic, even though the over all applied voltage across the potential deviding resistances remains well stabilized. These photomultipliers (5819, IP28 and 931–A) can be used without much error of nonlinearity up to maximum anode currents of the order of 25.0 μ amps, 25.0 μ amps and 40 μ amps respectively. This limitation over anode current was removed by stabilizing the individual dynode potentials for 5819 and 6364 tubes with the help of NE–2 neons and all kinds of potential fluctuations were found to be removed even for fairly large values of anode currents ~500μ amps for 5819 and 1000 μ amps for 6364 photomultiplier tubes.

8. Some New Logarithmic Circuits and Their Applications of Optics.

P. **Hariharan**, New Delhi.

Most of the defects of earlier logarithmic photoelectric circuits have been overcome in a new group of photo-electric circuits in which a logarithmic response is obtained over a wide range in two stages—an initial stage utilizing a photo-multiplier tube operated at constant anode current in which the range is compressed according to a known law, and a final stage having a logarithmic response over this comparatively restricted range. With such circuits it is possible to obtain an accurately logarithmic response over an illumination range as great as $10^9 : 1$, without any fatigue effects and without any risk of accidentally overloading the photomultiplier.

Circuits based on this principle have been utilized in a direct reading densitometer, a wide range, recording, logarithmic photometer and a double beam, ratio-recording spectrophotometer. Some applications of these circuits in Optics as well as in other branches of physics will be discussed.

9. A novel method of finding Refractive Index of Materials using coarse gratings.

Gopalamenon Sreekantath and **C. A. Verghese**, Trivandrum.

Refractive index of materials may be found accurately by a novel method using a pair of exactly similar coarse transmission gratings—about 150 to 200 lines/cm.—a spectrometer and sodium light.

A plate of the material, thickness t, is mounted with its plane vertical on the prism table with one grating in front and the other behind. The gratings are held on independent supports with their planes vertical and normal to the incident beam of parallel rays, the rulings of each being parallel to the vertical slit. When the slit is kept wide and the distance between the gratings is suitably adjusted, a system of equidistant dark interference bands is seen against the bright background of the various orders of the diffracted images of the slit. As the plate is turned from the position of normal incidence, the interference bands move across the crosswire. The number of bands getting displaced r is related to the angle of incidence i and to the refractive index μ of the material of the plate. μ can be calculated from the observed values of t, r and i. using the formula, $r\Lambda = t \sin i \left[1 - \sqrt{\frac{1-\sin^2 i}{\mu^2-\sin^2 i}}\right]$. Λ is the width of the grating element. The method is also applicable to a liquid, when taken in an optical cell.

10. Tuners for microstrip transmission line

S. S. **Srivastava**, Cochin.

Microstrip is a wide band transmission system in which the propagation of electromagnetic waves takes place through the dielectric, on one side of which there is the strip conductor and on the other a ground plane. A TEM mode can propagate itself in the microstrip, if the dielectric sheet is uniform and infinite and the losses are small. Recent work has indicated that the field and the power are concentrated in the dielectric between the conductors. A strip transmission line has been set up in the laboratory and measurements have been carried out on the characteristic impedance of various strips of different widths fixed on a sheet of polystyrene as dielectric. A coaxial line to strip junction was designed in the laboratory and a suitable plunger type tuner was also constructed to match the junction to the line. Tuners were provided at both the input and output junctions of the microstrip transmission line, the latter being connected to a matched load of 50Ω. Standing wave ratio on the line with these tuners has been measured in S band and these measurements are reported in this paper.

11. The conversion efficiency of a win dow-type magnetostrictive transducer in water.

D. Srinivasan and S. S. Srivastava, Cochin.

The radiation pressure due to the acoustic waves from a window-type magnetostrictive transducer of resonant frequency of 27.5 Kcs has been measured at different points on the axis of the acoustic beam. The measurement has been carried out by a vane type radiometer assembled in the laboratory. The acoustic output of the transducer for different gain-settings of the generator which drives the transducer has been measured and the efficiency of conversion into acoustic energy is calculated. The electro-mechanical efficiency is found to be 58%. This method is being used to calibrate different types of transducers which are being fabricated in the laboratory.

Optics Including Spectroscopy

1. Raman effect in Binary Liquid Mixtures.

K. Venkateswarlu and S. Natarajan, Annamalainagar.

Raman spectra are recorded for three binary systems of which two are Nonpolar-Polar and the other Polar-Polar group. In the two Nonpolar-Polar systems, namely, acetone-carbon tetrachloride and carbon tetrachloride-chloroform, deviations of intensities of prominent lines from proportionality to concentration are obvserved. In the other system Ethylacetate-chloroform no such deviation is observed. In all the cases studied no shift in frequency is observed.

2. Relative intensities of Raman Lines in Liquids.

K. Venkateswarlu and G. Thyagarajan, Annamalainagar.

The relative intensities of the Raman lines in liquid CCl_4 taking the intensity of the total symmetric line $\Delta\nu = 460$ cm^{-1} as unity have been estimated for two modes of illumination of the Raman tube, *viz.*, with the illuminating arc on the side and on the top of the tube. The instrument correction due to the effect of oblique refraction at the prism surface has been applied for both the modes of illumination. The breadths of the lines have also been taken into account. The relative intensities of Raman lines at $\Delta\nu = 217, 313, 460$ and 760-790 cm^{-1}, by both the methods after applying the necessary corrections are found to be .71, .89, 1 and .39. The values obtained by the authors by the photographic photometric method are in good agreement with the values obtained by Rank by the photoelectric method.

The variations in intensities and polarisation characters of the lines with the mode of excitation and the nature of the incident light (unpolarised, horizontally and vertically polarised) in the case of CCl_4, $CHCl_3$ and C_6H_6, are also being studied.

3. Joshi effect in air at low pressures.

H. D. SHARMA, Sagor.

The paper reports observations of the discharge current in dark and under visible light in air at low pressures from 1 to 27 mm.Hg. using Siemen's type all-glass ozonizers under the low frequency silent electric discharge. Contrary to the results of earlier workers, a large Joshi effect is observed even up to 1 mm.Hg. While the magnitude of the maximum Joshi effect near the threshold potential is found to diminish numerically as the pressure increases, the potential range over which the effect is observed is found to increase. These results are discussed on the hypothesis of photo-denudation.

4. The effect of Xenon on the First and Second Positive Systems of Nitrogen.

D. D. DESAI AND S. B. RAICHUR, Bombay.

The effects of Helium and Argon on the first and second positive systems of Nitrogen have been studied by the provious workers in this Laboratory. In continuation of this work, the study of the effect of Xenon is undertaken by the authors. The study is related to the effect of change of pressure of Xenon on the first and second positive systems of Nitrogen as well as the changes in the relative intensities of the bands with different percentage compositions of the mixtures. This has been attempted in the Laboratory using the technique of Photographic Photometry.

Preliminary observations indicate that the excess of Xenon in the mixture brings out the spectra of CN in trace occuring as impurity and the green group of the first positive system is enhanced in relation to the red and the orange groups.

5. Intensity measurements of bands of the first negative system of O_2^+

P. S. RAMCHANDRA RAO AND J. D. RANADE, Sagar.

Some bands of the first negative system of O_2^+ molecule ($b^4\Sigma_g \rightarrow a^4\pi_u$ system) have been recently observed by Nicolet, Vegard and others, in the spectrum of the aurora and has since been of ostrophysical interest. Theoretical calculations of the transition probabilities of these bands have been done by Jarmain, Fraser and Nicholles and also by the authors using different methods. These have been already reparted. In order to verify these results an experimental study of these bands is undertaken using the technique of photographic photometry. The bands are excited under different conditions and the absolute intensities have been measured. These are compared with the theoretical values, taking into account the different modes of excitation.

6. Production of active Nitrogen in High Frequency Discharge.

K. S. RAGHAVENDRA RAO AND N. R. TAWDE, Dharwar.

The conditions of production of active nitrogen by high frequency discharge have been studied systematically at a frequency of 11 Mc/s applied to a straight discharge tube by external electrodes permitting variation of interelectrode distance. The continuous flow method with a steady stream of gas is employed. Radical changes take place in the appearance of the discharge at conditions suitable for the production of active nitrogen. The discharge is not symmetrical with respect to the electrodes, either in form or in spectral character; the glow near the electrode through which the gas enters is narrow and violet in colour and exhibits the First and Second Positive systems of N_2. The glow near the electrode from which the gas leaves the discharge has intense sky-blue colour and exhibits the bands of the First Negative system of N_2^+ and the First Positive system of N_2. The Second Positive system is highly suppressed. The N_2^+ bands are observed even in the middle of the discharge with appreciable intensity. The appearance and intensity of the N_2^+ bands follow closely the appearance and intensity of active nitrogen. The observations so far made support Mitra's (1953) hypothesis. It is also suggested that the continuous flow method is an essential requisite.

7. A Spectroscopic Study of the Night Air Glow at Poona.

M. W. CHIPLONKAR, Poona.

The spectrum of the Night Air Glow at Poona was photographed on many clear and moonless nights during the period December, 1956 to April, 1957. The spectrograph was specially designed and built for the purpose. It has two F/2.5 photographic camera lenses (coated), with focal lengths of 163 mm (Taylor, Taylor and Hobson) and 178 mm (Kodak Aero Ektar), a large single glass prism of 140 mm base and 70 mm height and a complete slit head including a compur shutter, hartmann diaphragms step-sector (logarithmic) and a reflecting prism (Steinheil). An exposure of about four hours would suffice to record the prominent lines in the air glow. In all 27 successful spectra were obtained pointing the spectrograph towards the northern sky at an altitude of 30 degrees. The periods of exposure naturally commence and end at different times from the sunset and the sun-rise depending upon the phases of the moon. Thus during a single night total exposures varied from a maximum of about 11 hours to a minimum of 4½ hours. The photometry of the plates (Kodak P-1200) was carried out visually using a standardised wedge. In order to compare the intensities of the air glow on different nights use was made of the average curve of variation of intensity of the night air glow obtained at this place from our separate photometric investigation of the air glow using a photomultiplier type of photometer. The results of these measurements are presented and discussed in relation to those obtained by the author using a Rayleigh type of visual photometer at the same place in 1947-48.

8. The Near Ultraviolet Absorption Spectra of O, M and P Chloro Benzotrifluorides in the Liquid and Solid States.

I. ACHYUTA RAO AND V. RAMAKRISHNA RAO, Waltair.

This work is in continuation of our work on the vapour spectra.*

***Ortho* :**

Four bands in the liquid and nine in the solid phase are measured. The 0,0 band is fixed at 36335 cm^{-1} and 36169 cm^{-1} in the two phases respectively. The upper state fundamentals 995 in liquid and (290,666 and 1009) cm^{-1} in solid explain all the observed bands.

*** Rao, I. A. and Rao, V. R., *J.S.I.R.*, 16B, 320, 1957.**

Meta:

Five bands in the liquid and nine in the solid phase are measured. The 0,0 is fixed at 36261 cm^{-1} and 36195 cm^{-1} respectively. The observed fundamentals are 1000 and (384, 681 and 1010) cm^{-1} in the respective phases.

Para:

Four bands in the liquid and eleven in the solid phase are measured. The 0,0 band is fixed at 36781 cm^{-1} and 36835 cm^{-1} respectively. The upper state fundamentals are (521 and 1419) and (607, 1061 and 1424) cm^{-1} in liquid and solid phases.

The 0,0 band in the vapour phase was found in the Ortho, Meta and Para compounds at 36598 cm^{-1}, 36547 cm^{-1} and 36943 cm^{-1} respectively. The corresponding shifts of the 0,0 from vapour to liquid are (−265, −290 and −170) and from liquid to solid are (−160, −69 and +57) cm^{-1} respectively.

9. On the Emission Spectrum of Benzaldehyde

S. N. GARG, I. S. SINGH AND N. L. SINGH, Varanasi.

The emission spectrum of benzaldehyde has been extended under critical conditions of excitation by transformer discharge through flowing vapour. The spectrum lies in the region 3679 - 5983A° and comprises more than 325 bands. The excited frequencies of the ground state are: 1733, 1596, 3045, 1204, 1003, 245, 430, 775, 828, and 1167 cm^{-1}. The main frequency at 1735 cm^{-1} is identified with the C = 0 stretching frequency. Other totally symmetric as well as non-totally symmetric frequencies are found to be superposed over this main frequency and its multiples. A more comprehensive analysis of the benzaldehyde bands will be presented on the strength of these additional bands.

10. The near ultra-violet emission spectrum of o-dimethyl benzene.

I. S. SINGH AND N. L. SINGH, Varanasi.

The near ultra-violet emission spectrum of 0-dimethyl benzene was obtained by transformer and high frequency discharges through flowing vapour of the sample, the vapour pressure being about 2 mm. The spectrum was photographed on a Hilger large quartz spectrograph. The emission spectrum is observed to be in the region 2648–2962 A and consists of 58 bands. The emission spectrum has been obtained for the first time. Totally symmetric vibrations are observed to occur in progressions and to form combinations with other vibrations of suitable symmetry.

11. The Symmetry Type of the First Excited Level of Benzoquinone.

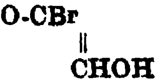
RAMA SHANKAR SINGH, Varanasi.

The visible absorption bands of benzoquinones in vapour state which extend from 4800A to 4100A consist of 7 main groups. Attempts to analyse the bands as due to an allowed transition fail, but they are best understood if interpreted as due to forbidden transition made allowed by 538 cm^{-1} Raman active (*g*) type of vibration. Symmetry considerations then enable us to interpret the system as due to an $n - \pi$ (Ag ← Au) transition.

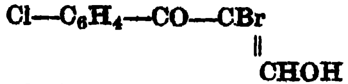
12. Absorption spectra of some Bromo-oxy-methylene Ketones and their derivatives.

K. P. Verma, Naini Tal.

Quantitative study of the absorption spectra of solutions of some newly synthesised organic compounds has been made with a view to elucidating their structure. The compounds are :

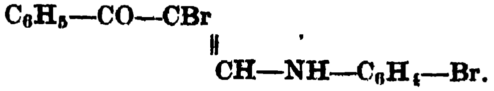
(I) Bromo-oxymethelene acetophenone  $C_6H_5\text{-}CO\text{-}\underset{\overset{\|}{CHOH}}{CBr}$

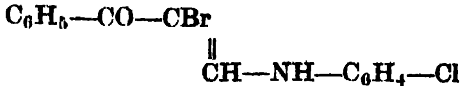
(II) Bromo Oxymethylene *p*-chloro-acetophenone



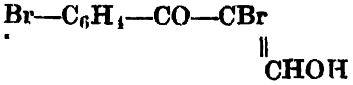
$Cl{-}C_6H_4{-}CO{-}\underset{\overset{\|}{CHOH}}{CBr}$

and their derivatives.

(III)  $C_6H_5{-}CO{-}\underset{\overset{\|}{CH{-}NH{-}C_6H_4{-}Br.}}{CBr}$

(IV)  $C_6H_5{-}CO{-}\underset{\overset{\|}{CH{-}NH{-}C_6H_4{-}Cl}}{CBr}$

(V) Bromo-oxymethylene *p*-bromo-acetophenone:



$Br{-}C_6H_4{-}CO{-}\underset{\overset{\|}{CHOH}}{CBr}$

(VI) Isonitro Bromo-acetophenone.

Bromo-oxymethylene acetophenone (I) exhibits two peaks of absorption, one at 255 mμ and the other at 320 mμ. Similarly, bromo-oxymethylene *p*-chloro-acetophenone (II) shows two peaks, one at 260 mμ and the other at 330 mμ. Compounds (III) and (IV) also show absorption in 330 mμ region. Compound (V) shows a peak at 248 mμ. A low intensity long wave-length absorption band at 380 mμ which appears in compound (II) is absent in compound (V). Compounds (VI) exhibits peaks at 218 mμ and 264 mμ. The absorption bands at 255 mμ and 260 mμ appear to be due to the presence of the benzil group while those at 320 mμ and 330mμ seem to be due to the presence of Keto-group, through there is a noticiable shift in the $>$ CO band.

13. Absorbtion spectra of Phenol Ortho-Nitro Phenyl Succinic Acid and Resorcinol Ortho-Nitro Succinic Acid.

K. P. Verma, Naini Tal.

There is an ever growing appreciation of the value of quantitative absorbtion spectrophotometry in relation to purification, identification and structural elucidation of organic compounds and the application of these methods has been greatly facilitated in recent years by the availability of excellent equipment. Study has been made of the absorbtion spectra of solutions in alcohol of some newly synthesised organic compounds with a view to elucidating their structure. The compounds are phenol ortho-nitro phenyl succinic acid (I) and resorcinol ortho-nitro phenyl succinic acid (ii). The scope of the work has been limited to electronic absorbtion in the visible and ultra-violet regions.

The compound (I) exhibits two Peaks at 234 mμ and 275 mμ. The compound (II) shows peaks at 255 mμ, 480 mμ and 530 mμ. The chromophores in these compounds appear to be phenol (λ_{max} at 273mμ) and Resorcinol (λ_{max} at. 273mμ). Compared to phenol, compound (I) shows a displacement of wavelength of maximum absorbtion towards longer wavelength (bathochromic shift). But compared to resorcinal, compound (II) shows a displacement to shorter wavelength of the wavelength of maximum absorbtion (hypochromic shift).

It is the region of low intensity absorbtion between 230 mμ and 270 mμ, which is most characteristic of benzene and all its derivatives; when modified by substituents these absorbtion bands are known as "benzenoid absorbtion". The peaks at 234 mμ and 255 mμ appear to be due to 'Benzenoid Absorbtion".

14. Near ultraviolet emission spectrum of para–cresol.

N. L. SINGH AND R. K. RAO, Varanasi.

The emission spectrum of para-cresol was obtained by means of an uncondensed transformer discharge through the flowing vapour of the substance. The whole spectrum consists of nineteen bands in the region 2810–3090 A superposed on a continuum beginning at about 2830A and extending to beyond 3300A. The emission spectrum is the counterpart of the near ultraviolet absorption spectrum of the molecule. A tentative vibrational analysis of the spectrum is proposed in terms of four ground state frequencies and one excited state frequency of the molecule. All but one of the suggested ground state frequencies find support from the Raman data.

15. On the Fine Structure of Energy Transfer in Diphenyl—Anthracene System.

H. N. BOSE AND M. L. BHAUMIK, Kharagpur.

The nature of the fluorescence spectra of both the impurity and the matrix in a solid solution of anthracene in diphenyl is found to vary with impurity concentrations. With increasing concentrations the intensity maximum of the impurity fluorescence pattern seems to shift towards longer wave lengths, while in the matrix emission pattern some of the bands appear to show preferential decrease in intensity in addition to the general intensity diminution of the whole pattern due to transfer. The change in the impurity emission bands is shown to be due to self-absorption of the impurity itself. The matrix bands showing preferential decrease in intensity are found to occur at the same positions as those of the impurity absorption bands in the solid solution. Also the amount of decrease in the different matrix bands is found to be directly proportional to the absorption co-efficients of the corresponding impurity absorption bands. Further quantitative investigations are in progress to decide whether the decrease in intensity of these matrix bands is due to direct absoption by the impurity or there is a preferential transfer of energy from these bands.

16. On the complex band spectrum of TiCl.

P. TIRUVENGANNA RAO AND D. V. RANGA RAO.

The complex band spectrum of the diatomic molecule TiCl, has been reinvestigated in a high frequency discharge through flowing titanium tetrachloride vapour under low pressure conditions. A new group of 25 bands in the region $\lambda\lambda$4270—4220 has been obtained on the long wavelength side of system I, reported earlier by Parker and Ramakrishna Rao. The structure of this new group is remarkably similar to the (0,0) sequence of system I and is interpreted as the (0,1) sequence of the same system I. The multiplet analysis of the (0,0) sequence has been earlier carried out by Ramakrishna Rao on the basis of a $^4\pi - ^4\Sigma$ transition. This multiplet analysis has been extended to the (0, 1) sequence. It is found that the recurring wave number interval of roughly 30 cm^{-1} between the four different components of the upper state, gives the approximate value of the magnetic coupling constant A for this state. The interval separations between the rotational heads of different forms of the same upper component state vary between 6 to 13 cm^{-1} as corresponding intervals in the (0, 0) sequence. The assignment of system I to $^4\pi - ^4\Sigma$ transition is thus confirmed.

17. The Ultra-Violet Absorption Spectra of NH_4 Cl–TlCl Solutions

S. C. Sen, Kharagpur.

When thallous chloride is dissolved in concentrated aqueous solutions of halides like KCl, NaCl, HCl, $CaCl_2$ and KBr etc, the new selective band appears in the absorption spectra with peaks at 2475 Å for the chlorides and 2650 Å for bromides which do not occur in pure halides. Scott and Hu determined the dissociation constants for thallous chloride complexes in concentrated (KCl, NaCl, and NH_4Cl) aqueous solutions from solubulity measurements. So it has become possible to calculate the components of the individual ions Tl^+, TlCl, and $TlCl_2^-$ present in a mixed solution. Several workers have calculated the molar absorptivities for different wave-lengths of these complex ions Tl^+, TlCl, and $TlCl_2^-$ in concentrated (KCl, and NaCl) aqueous solutions from the measurement of absorption curves. Working on the same lines the molar absorptivities of the said complexes Tl^+, TlCl, and $TlCl_2^-$ in NH_4Cl solutions have been determined from the measurement of absorption curves. The results of the present investigation agree with the idea of complex formation in aqueous solutions of NH_4Cl—TlCl.

18. F-19 hyperfine Interaction in the paramagnetic spectrum of Mn ions in ZnF_2.

A. Mukherjee and T. P. Das, Calcutta.

The F^{19} *hfs* observed by Tinkham in the paramagnetic resonance spectrum of Mn^{++} ions dissolved in ZnF_2 is interpreted in terms of the overlap of the wave-functions of the Mn^{++} and F^- electrons in the crystal.

19. Fluorescent spectrum of Frozen solutions of Uranyl Nitrate in some organic solvents.

D. P. Khandelwal, Naini Sal.

Nichols and Howes (1919) studied the fluorescent spectra of solutions of uranyl nitrate in methyl and ethyl alcohols at liquid air temperature. Five to six bands ($\Delta\nu \sim$ 850 cm^{-1}) are reported. In Methanol each band had two components, whereas in ethanol only the first band showed two components. In the present investigation the spectra of solutions of equal concentration (0.4M) of the salt in Methyl, ethyl, butyl, hexyl and benzyl alcohols and ether have been quantitatively examined to ascertain the influence of these solvents on the spectrum. The red component of each band, which corresponds to the spectrum of the solid is termed α, and the other component ($\Delta\nu \sim 200$ cm^{-1}) α′. It is found that (1) in the first group α′ is weak compared to α in methanol, and gains in intensity as we go to higher alcohols, so that in hexyl alcohol α′ is much stronger than α. In ethereal solution only the α′ bands appear. (2) As we pass to higher groups, α′ gains in intensity relative to α in all cases. (3) The frequencies of the bands remain the same through all the alcohols, as also in ether.

20. Fluorescence of uranyl Nitrate Incorporated in Boric Acid Glass and effect of hydration on the Fluorescent spectra.

C. M. SUNTHA AND D. P. KHANDELWAL, Naini Tal.

The luminescence of uranyl nitrate incorporated in boric acid glass has been studied. At room temperature the spectrum differs from that given by the pure salt in three respects: (a) there is a shift of the entire spectrum toward the red by$\sim$270 cm^{-1}, (b) the intensity distribution between the bands shifts appreciably to the short wave-length side and (c) three bands due to transitions from $v' = 3$, 2 and 1 are observed as against only one ($v' = 1$) in the pure salt. On cooling to liquid air temperature there is no further resolution of the bands, but a new series of bands shifted by 400 cm^{-1}. toward the red appears. On hydration the glass converts to brittle form and the spectrum becomes almost continuous. Dehydration does not return the sample to glassy form, while the spectrum does return to the original. Another sample incorporating uranium oxide gave at room temperature a spectrum identical with that obtained with uranyl nitrate, but at liquid air temperature only the bands belonging to the new series, referred to above, were present.

21. effect of water of crystallisation on the Fluorescent spectrum of uranyl sulphate.

B. C. PANDEY, Naini Tal.

A study of the variation of the fluorescent spectrum of uranyl sulphate at liquid air temperature with change in water of crystallisation has been made. The salt was kept at varying constant temperatures for prolonged periods, and the water content determined gravimetrically. Three discontinuities are found in the hydration – temperature curve, and can be correlated with changes in the spectrum. For samples containing 2.58, 2.54 and 2.43 molecules of water the spectrum contains the usual A and B bands with no change in relative intensity. With 0.75 and 0.54 molecules of water there appears an additional series of diffuse bands (λ508 mμ, 531 mμ,...), whereas with 0.48 and 0.37 molecules of water the A and B bands disappear and only a diffuse series is seen with different location of bands (λ489 mμ, 510 mμ..). The different diffuse series represent the formation of various hydrates. Levshin's view that at least one molecule of hydration is necessary for the emission spectrum is obviously untenable. The rapid falls in the temperature – hydration curve are associated with decrease of intensity as well as change in the spectrum, and the slower falls with only decrease of the total intensity.

Crystallography, X-Ray Etc..

1. Energy States Of A One-dimensional Crystal with Vacant Lattice Sites.

A MOZUMDER, KHARAGPUR.

In this paper, the effect of regularly spaced vacant sites (in an otherwise perfect one-dimensional crystal) on the electronic energy states has been investigated. Use has been made of the calculated energy levels in determining the % changes in electrical conductivity and the low frequency limit (ν_f) of fundamental absorption band. The unperturbed problem has been based on the one-dimensional crystal model of Kronig and Penny with $a-\delta$-potential of strength A at each lattice point. By solving the usual eigenvalue equation, this gives an unperturbed $\nu_f = \frac{h\delta(2+\delta)}{8ma^2}$, where a = lattice constant; m = mass of electron and $\delta = \frac{8maA}{h^2}$. In the perturbed problem, the perturbing potential is supposed to be a negative -δ-potential at each vacant site with the same strength A. By normalising the unperturbed wavefunction in the usual way and calculating the matrix elements, etc., the perturbed energy correct to the first order is given as $\frac{h^2\phi^2}{2ma^2} - \frac{A}{Sf(\phi,\lambda)} \cdot \frac{Sin^2\phi}{Sin^2\frac{\lambda+\phi}{2}}$, where the vacancy concentration is 1 in S; $\phi = \frac{a}{h}\sqrt{2mW}$, W being the unperturbed energy ;

$$f(\phi,\lambda) = a\left[1 + \frac{Sin^2\frac{\lambda-\phi}{2}}{Sin^2\frac{\lambda+\phi}{2}} - 2\frac{Sin\ \phi}{\phi} \cdot \frac{Sin\ \frac{\lambda-\phi}{2}}{Sin\ \frac{\lambda+\phi}{2}}\right];$$

ϕ and λ are related through the eigenvalue equations $\theta\frac{\sin\phi}{\phi} + \cos\phi = \cos\lambda$; $\theta = \frac{maA}{\hbar^2}$

The second and higher order energy corrections are negligible. The perturbed value of ν_f calculated from the above expression shows a % decrease of about $(100/S)$%, which result is expected semi-classically. The % increase of the electrical conductivity of the sample due to the lessening of the band gap by vacancies is calculated with the help of the usual exponentially dependent formulae for σ on band gap (E). This gives a% increase of about 100E/SKT; K = Boltzmann constant; T = absolute temperature of the sample. The following features of the calculation may be noted :

i) Vacancy always lowers the energy levels although the amount of lowering is different in case of different energy levels.

ii) Energy at the top of the valence band remains unaffected due to vacancies. It is only the energy at the bottom of the conduction band, the lowering of which lowers the band gap E.

iii) The % change in electrical conductivity is much more pronounced than the % change in ν_f. This is due to the exponential nature of variation of σ with E.

iv) The % change in ν_f is the same for all crystals with the same vacancy concentration. The % change in σ depends, on the other hand, on both S and E. Knowing E from fundamental absorption data, electrical measurement can, therefore, evaluate S.

2. A Microwave Analogue for X-Ray Diffraction.

G. B. MITRA AND G. S. SANYAL, Kharagpur.

Diffraction of X-rays by crystals has been explained by assuming X-rays to be electromagnetic waves which are scattered by atoms whose three dimensional regular arrangement forms the crystal. Constructive interference in certain directions gives rise to the diffraction pattern and unravels the secrets of the crystal structure. If now X-rays are replaced by microwaves and atoms by scatterers, identical phenomena as obtained with X-rays interacting with crystals should be observed. To verify this, a three dimensional lattice with brass cylindrical scatterers at the lattice points was constructed. Lattice constants were $a = b = 3.2$ cms, $c = 4.8$ cms and the wavelength of microwaves used was 3.2 cms. The lattice was 10 layers, 10 layers and 9 layers deep in the X, Y and Z directions so that there were in all 900 unit cells in the lattice. Placing the transmitting and receiving microwave horns each at 30° to the (100) planes a reflection maximum was obtained. Similarly, placing the source and the detector each at 44° to the (110) planes another maximum was obtained. Both these check with Bragg equation $2d \sin \theta = \lambda$ for the (100) and (110) planes of the lattice. Thus Bragg law was found to be satisfied. Half intensity widths of the (110) reflection for the crystal model having 10 llayers, 9 layers and 4 layers in the Y direction were determined. These were found to agree fairly with the half intensity widths calculated from Scherrer formula.

3. Dielectric properties of NaCl Single Crystals under X-ray and γ-ray irradiation.

K. V. RAO, Kharagpur.

Dielectric constant and dielectric loss measurements on single crystals of NaCl have been made by the resonance curve method in the frequency region 50 Kc./s—15 Mc/s at room temperature. Before X-ray excitation no loss was observed in this frequency range. After X-ray excitation, for one hour (55 Kv., 15 ma.) the sample showed about 1.0% increase in capacity at all frequencies while no detectable dielectric loss was observed. Bleaching the sample by heating it at 250°C. for half an hour restored the sample capacity to almost the value before excitation whereas the crystal exhibited a dielectric loss in the frequency region 50 Kc.—2.0 Mc., the loss decreasing with increasing frequency. The equivalent parallel resistance of the sample is greater than 20 megohims ($\tan \delta = 0.01$). The F-band absorption was measured by Beckman Spectrophotometer and the number of F-centres produced by X-ray excitation was calculated. Similar results were obtained on another sample with γ-ray irradiation. It is believed that the capacity changes with the two types of excitation are due to the filling and emptying of electron traps whereas the dielectric loss changes seem to be connected with the vacancies created by the irradiation and subsequent thermal bleaching of the colour centres.

4. Production of Magnetic Centres in Alkali Halides by X-ray and γ-ray irradiation.

AMALENDU CHOWDHURY, Kharagpur.

The number of magnetic centres in single crystals of alkali halides (NaCl, KCl, LiF) coloured with x-rays and γ-rays has been determined and the corresponding number of optical absorptioncentres has been compared with the number of magnetic centres. The magnetic centres have been determined by a Quarts micro-balance, working in vacuum The variation of the number of centres with the temperature of heat treatment of the specimen has been also compared with the number of optical absorption centres and with the centres of luminescence. The number of magnetic centres is much larger than that determined from the optical absorption due to the F-band, which clearly shows that due to X-ray and γ-ray irradiation, a number of centres other than F-centres are also created contributing to the decrease of diamagnetic susceptibility of the material. After heat treatment up to a certain temperature, the specimen regains its original diamagnetic susceptibility within experimental error. On heating the decays of the magnetic number of centres and that of the centres contributing to the thermoluminescence are found to be of the same nature. The crystals coloured with X-rays and γ-rays are seen to have the same nature of changes in both magnetic and in other optical measurements.

5. Measurement of the Activation energy of Copper by the X-ray diffraction Method.

G. B. MITRA AND S. K. MITRA, Kharagpur.

The lattice constants of copper and copper aluminium alloys at various temperatures were determined very precisely by the X-ray diffraction method. The plots of the logarithm of the anomalous thermal expansion obtained from such data against the reciprocal of the temperature in degrees Kelvin were linear. The inclination of such straight lines to the reciprocal of the temperature axis was a measure of the activation energy. The activation energy thus measured varried between .2ev to .5 ev showing that they were all due to vacant lattice sites. The differences in the values for the different cases have been attributed to different atomic surroundings.

6. The Thermal Oxidation of Cu (111) and (100) faces.

Y. N. TREHAN AND A. GOSWAMI, Poona.

The thermal oxidation of Cu (111) and (100) faces was carried out in air in the temperature range 120°–350°C. The initial oxide layer formed consisted of cuprous oxide having an amorphous or a fine grained structure. Increase in film thickness with temperature and /or time of oxidation resulted in the formation of crystalline Cu_2O epitaxially with a two-degree $\{111\}$ orientation on both the faces. With further increase in thickness, mixed two-degree $\{111\}+\{100\}$ orientated Cu_2O was formed, which showed evidence of $\{111|$ twinning. Below 200°C, these orientated Cu_2O layers were covered with randomly disposed and finally with one-degree orientated Cu_2O. Above 200°C, with sufficient time of heating, CuO layers, two-degree orientated, randomly disposed or one-degree orientated, were formed over the initial Cu_2O layers. The one-degree orientation of CuO, however, varied with temperature. The formation of the $\{100\}$ orientation in Cu_2O layers has been explained on the basis of multiple twinning. The crystal growth process and the mechanism of oxidation have been discussed.

7. New Forms of Bismuth Oxide.

P. S. AGGARWAL AND A. GOSWAMI, Poona.

Bi_2O_3 is known to have three well-defined crystal forms (monoclinic, $a_0 = 5.83$Å, $b_0 = 8.14$Å, $c_0 = 13.78$Å, $\beta = 90°$; cubic (b.c.), $a_0 = 10.08$Å; cubic,$a_0 = 5.25$Å); the

structure of Bi_2O_5 has not been reported. The existence of a suboxide (BiO) has occasionally been reported, but its structure has not yet been established. However, by heating evaporated films of bismuth in air under different conditions, two cubic oxides of bismuth ($a_0 = 5.65$ Å, $a_0 = 7.02$ Å) have been identified by electron diffraction. The intensities of various reflections suggest that they were of f.c.c. type and at least one of them had a sphalerite structure.

8. Study of Crystal Dislocations by Vacuum Metallization.

V. R. GURU MOORTI AND M. K. GHARPUREY, Poona.

The texture of zinc films deposited from vapour in vacuo are extremely sensitive to the nature of the substrate surface. If the zinc vapour stream is incident on a single crystal of stearic acid, the surface of the crystal becomes uniformly coated with zinc except at the regions near the steps on the surface. As a result the growth spirals due to screw dislocations are strikingly revealed even in a medium power optical microscope.

Various types of single, multiple and interlaced growth spirals on crystals of stearic acid, *n*-paraffin and stearic acid with traces of *n*-paraffin, revealed by this new technique are illustrated and discussed.

9. Semi-conducting Antimony Telluride.

S. K. GHOSH AND C. RAMASASTRY, Kharagpur.

The compound Antimony Telluride was prepared by melting together antimony and tellurium in the ratio 3.86 : 6.14 by weight which corresponds to the formula Sb_2Te_3. The melting was done in a vacuum sealed vicor tube and single crystals were grown by the process of slow cooling. From the sign of the thermo e.m.f. the crystals were found to be highly *p*-type. The variation of its electrical resistance was measured as a function of temperature over the range 300°K to 520°K. From the high temperature portion of the graph of log resistance versus 1/T°K, the forbidden energy gap between the valency and conduction bands is estimated to be 0.32 e.v. The low temperature portion of the same graph gives 0.06 e.v. for the ionization energy of the acceptor level.

10. The Deranged Structure of Anthrone Crystals.

K. BANERJEE, Allahabad.

Anthrone crystallises very similarly as anthraquinone from which it differs chemically only in the replacement of one oxygen atom by two hydrogen atoms. From rotation photographs the cell is found to have nearly the same dimensions as that of anthraquinone except for the appearance of very diffuse layer lines midway between the layer lines with sharp spots for rotation about the *b*-axis. The absent planes indicate a glide plane and a screw axis. If the diffuse layers are disregarded, it indicates a molecular centre of symmetry which is against the chemical formula. This anomalous behaviour is explained by a structure in which the basis is the anthraquinone structure with the oxygen atom and the pair of hydrogen atoms oppositely arranged in the consecutive molecules in adjacent unit cells along the *b*-axis. This arrangement being an extremely short distance order, in long distance arrangement of the basic anthrone molecule perfect regularity exists.

11. X-ray analysis of frozen pyridine and its solution at $-180°C$.

S. C. SIRKAR AND S. G. BISWAS, Calcutta.

Debye-Scherrer patterns of pure pyridine and its solution in the frozen state at $-180°C$ have been studied and two different patterns due to crystals of pyridine have been observed. Analysis of the patterns shows that the first modification belongs to the space group Q_h^1 with a = 12.16 A.U., b = 9.14 A.U., c, = 8.48 A.U. and the second modification belongs to the space group Q_h^2 with cell dimensions a = 11.00 A.U., b = 9.27 A.U.,, c = 8.98 A.U. The density of the crystals has also been measured and is found to be 1.134. The number of molecules in the unit cell is found to be 8 in both the cases.

It is pointed out that pyridine molecule is asymmetric in both the modifications and that the formation of weak bonds among the molecules in the solid state may be the cause of such asymmetry. The frozen mixture is found to be amorphous. These results are compared with those of the investigations on the Raman spectra of crystals of pyridine and of frozen mixtures of pyridine by previous workers and it is concluded that complex groups of molecules produced new Raman band in the frozen mixtures.

12. The Crystal Structure of p-Azo-Toluene.

V. M. PADMANABHAN AND JAGDISH SHANKAR, Bombay

The crystal structure of *p*-azo-toluene has been determined by single crystal methods. The unit cell is monoclinic with $a = 12.01$ Å, $b = 5.02$Å, $c = 9.32$ Å, $\beta = 90°12'$. The space-group is $P2_1/a - C_{2h}^5$ and there are two molecules per unit cell.

Atomic positions were determined by electron density projections, making use of 'trial and error' methods. Structure factors were obtained from visually estimated intensities on Weissenberg photographs taken with CuK radiation.

The planar benzene rings are attached by zig-zag $C-N=N-C$ bond with the bond distance $-N=N- = 1.27$Å and the angle $N=N-C$ 134°30′. The plane of the benzene ring makes an angle of 42°34′ with the *ac* plane; its orientation is obtained by rotating it about the $N-C$ bond by 12°. The nearest distance between two molecules in the crystal is 3.12°A.

13. Quenching effects in cadmium and antimony.

C. K. SUNDARACHAR AND S. L. SRIKANTAIYA, Mysore.

The change, brought about by quenching in the electrical resistivity of polycrystalline cadmium and antimony, has been studied experimentally. Experiments were also conducted to study the Hall effect in antimony quenched from temperatures in the range of 150°–250°C to 25°C. The behaviour of cadmium in respect of its resistivity, when quenched from temperatures in the range of 75-175°C., is similar to that of gold as observed by F. S. Bradshaw and S. Pearson, (Phil. Mag. **1**, 812, 1956). The anomalous behaviour of antimony when quenched from temperatures in excess of 150°C, arises, presumably, from its complex crystalline structure and its properties, intermediate between those of ideal metals and valence types.

14. On the Linear rate of crystallization of PP′ DDT.

S. B. KULKARNI AND M. K. GHARPUREY, Poona.

A phase transition, such as solidification from a super-cooled melt, takes place in two distinct steps : (i) nucleation of the stable phase, (ii) further growth of this nucleus at a certain linear rate—the linear rate of crystallization. Two growth mechanisms are generally assumed: (i) Repeated two dimensional nucleation on the surface of the crystal, (ii) Growth around dislocations already present in the surface.

From a study of the linear rate of crystallization at various degrees of super-cooling of *PP'* DDT (para-para-dichloro-diphenyl trichloroethane) and of PP' DDT containing various additives it is found that the logarithm of the rate of crystallization against the reciprocal of the absolute temperature exhibits a discontinuity at about 60°C. The agreement between the activation energy values evaluated from these data and also from melt viscosity and density data appear to correspond satisfactorily.

The experimental results are discussed in terms of various factors.

15. The crystal structure of Cobalt (III) Acetylacetonate.

V. M. PADMANABHAN, Bombay.

The crystal structure of cobalt acetylacetonate $Co(C_5H_7O_2)_3$ has been determined by X-ray diffraction. The crystals are monoclinic with $a = 14.16$, $b = 7.48$, $c = 16.43$ and $\beta = 98°41'$. The unit cell contains four molecules and the space group is $C_{2h}^5 - P2_1/c$. The trial structure was deduced from Patterson projections and electron density projections. The approximate atomic coordinates were refined till the R factor reduced to 0.18. Three acetylacetonate radicals surround the central metal atom with the oxygens in octohedral coordination. The three radicals have a planar configuration. The Co—O distance is less than the normal ionic distance and explains the stability of the molecule.

16. Crystal Distortion in $A_x\ Ni_{1-x}\ Mn_2\ 0_4$ Systems

N. R. SANJANA, A. P. B. SINHA AND A. B. BISWAS, Poona.

Compounds of the general formula $A_xNi_{1-x}\ Mn_2O_4$ (where $A = Mn^{2+}, Cd^{2+}, Zn^{2+}, Mg^{2+}$ and $x = 0$ to 1 at intervals of 0.1) were prepared by solid state reactions between x moles of AMn_2O_4 and $(1-x)$ moles of $NiMn_2O_4$. The lattice parameters and the ionic distribution in these compounds were determinod at room temperature after heating for 24 hours at temperatures, 1000°, 1100°, and 1200°C, by X-ray powder diffraction technique. All the phases with $x > 0.6$ had the tetragonal hausmanite structure and those with $x < 0.5$ had the spinel structure. The c/a value for all the tetragonal phases with the common A was constant. Furthermore, the A ions always occupied the tetrahedral and Ni ions octahedral sites. The Mn ions occupied the remaining tetrahedral and octahedral sites. No ordering of the cations was observed.

The results are explained on the basis of the effect of crystal field on the nature of bonding.

17. Thermodynamics of Tetragonal to Cubic spinel Transformations.

K. S. IRANI, A. P. B. SINHA AND A. B. BISWAS, Poona.

Compounds of the general formula $A^{2+}Mn_2^{3+}O_4^{2-}$ having the tetragonally distorted spinel structure were prepared by solid state reactions between a bivalent oxide AO (MgO, ZnO, CoO, FeO, NiO) and Mn_2O_3. These compounds were studied by the differential thermal analysis, and the heating curve of each one of them showed an endothermic peak, which, as ascertained by the high temperature X-ray diffraction analysis, was due to a reversible phase transformation from tetragonal to cubic symmetry. The transition temperature and th heat of transformation increased linearly with increase n the degree of distortion (c/a).

The observed entropy of transformation ΔS is almost the same in all cases $\sim$ 3 cal. /degree/gm. mole). This increase in entropy (disorder) at the transition temperature is due to randomisation of the ionic bonds which are parallel to the crystal c axis before transition. Theoretical considerations lead to the equation

$$\Delta S = xk . \log_e 3$$

where 'x' is the number of manganese ions per gm. mole at the octahedral site. The value of 'x' varies from $x = 2N$ for a 'normal' spinel to $x = N$ for 'inverse' spinel, and thus the calculated value of ΔS lies between 2.16 and 4.32 cal/degree/mole.

Absolute values of entropy at different temperatures were calculated using Debye's equation for specific heats. The universal curve relating C_v/n to $a(= T/\theta_D)$ was used to get another curve relating C_v/na against a. This plot enabled the evaluation of $\int_0^\infty \frac{C_v}{na}\, da$ for various a values. The $\int^\infty \frac{C_v}{na}\, da$ equals S/n, because $C_p \quad C_v$ for solids. Thus a universal curve relating S/n with a was obtained. Accordingly, a convenient method to calculate the entropy values is suggested in which either the Debye temperature (θ_D) or the entropy at any one temperature should be known.

18. Vibrational spectrum and Thermodynamical Properties of Zinc Manganite.

SHARDA DASGUPTA AND A. B. BISWAS, Poona.

Zinc manganite ($ZnMn_2O_4$), prepared by solid state reaction between ZnO and $Mn_2\ O_3$ at 900°C, forms a tetragonally distorted and normal spinel-like structure. Its infra-red absorption spectra betwen 5800-350 cm^{-1}, containing mainly three strong bands at 546 cm^{-1}, 423.7 cm^{-1} and 362.2 cm^{-1} respectively, have been analysed. Zn^{2+} is tetrahedrally coordinated (sp^3) with four oxygens whose stretching force constant is 1.395×10^5 dynes/cm. Mn^{3+} at the octahedral site forms four covalent (square, coplanar dsp^2 type) bonds and two linear ionic bonds, with six oxygens, the corresponding force constants being 1.069×10^5 dynes/cm. and 0.78×10^5 dynes/cm. respectively. Further, the compressibility, Debye temperature and specific heat (C_v) have been evaluated from the above data and the results are discussed with reference to other manganites and ferrites.

19. Temperature Dependance of crystal distortion in spinels

K. S. IRANI, A. P B. SINHA AND A. B. BISWAS, Poona.

A number of compounds of the formula $A^{2+}Mn_2{}^{3+}O_4{}^{2-}$(where A = Mn, Mg, Zn, Co, Fe), possessing tetragonally distorted spinel structure at room temperature, have been studied by X-ray diffraction at elevated temperatures, using a modified Unicam high temperature camera. The DebyeScherrer patterns with Mo-K α radiation were used for the determination of the lattice constants and distribution of cations at various temperatures. Although both the c and a values show a slow increase with temperature, the c/a values remain surprisingly constant till the transition temperature, at which point, the c/a falls to unity and the substance takes up the cubic symmetry isomorphous with well-known spinels.

The ionic bonds which are frozen parallel to the crystal c axis at very low temperature gradually get randomised at elevated temperatures causing a decrease in c axis and increase in the a axis. However, this effect is pronounced near the transition temperature whilst at lower temperatures the thermal expansion of the lattice predominates showing a slight increase in c and a parameters.

20. Crystal structure and Infra-red Absorption spectra of cadmium indate.

M. SKRBLJAK, SHARDA DASGUPTA AND A. B. BISWAS, Poona.

Cadmium indate ($CdIn_2O_4$) has been prepared by solid state reaction between CdO and In_2O_3 at 800°C. An X-ray powder diffraction analysis showed the structure to be isomorphous with the spinel structure with $a = 9.118$ Å $\pm$ 0.005. The metal ions occupy special sites and from a consideration of their electronic configurations it is deduced to be the same as in "normal" spinel. The 'u' parameter of the cubic close-packed oxygens is 0.390 $\pm$ 0.010.

Three main infra-red absorption bands (between 500 and 300 cm^{-1}) have been observed and interpreted. From these the optical activation energy and force constants for the stretching of bonds between oxygen ions and the tetrahedral or octahedral cations have been calculated, as also the compressibility and the Debye temperature of the substance.

21. X-ray Diffraction patterns of Paraffin Wax subjected to Electric Fields with electrodes of different metals.

K. C. CHANDY AND R. D. BHAWALKAR, Sagor.

During the investigations on Electrets prepared from Carnauba Wax, it was found that the electric field and the material of the electrodes have considerable effect on the electric behaviour of Carnauba wax. Paraffin wax is known *not* to give electrets as it consists of non-polar hydrocarbons. In the existing literature there are conflicting reports on the polarisation induced in waxes under the influence of electric fields. Hence a thorough investigation was carried out on paraffin wax to study its structure under different conditions of electric and heat treatments similar to those used in Electret preparation from Carnauba wax. A number of X-ray Diffraction photographs were taken from Paraffin wax samples prepared, (i) with and without electric fields, (ii) by using different metal electrodes and (iii) by using different types of apparatus for preparing samples. X-rays were allowed to pass (i) parallel and (ii) perpendicular to the direction of the electric fields used during solidification. No marked fibre structure was noticed in general. However, in a few cases slight variation of intensity was noticed. Plausible theoretical explanations of these observed facts are given.

22. Structure of Electrets prepared from Carnauba Wax.

K. C. CHANDY AND D. R. BHAWALKAR, Sagor.

Though Carnauba wax is the basic material for electrets preparation, normally bees wax and resin are added to it. In order to investigate the structural changes during electret formation, only Carnauba wax was subjected to electric and thermal treatment in the same way as is done in electret perparation Three varieties of Carnauba wax were available and samples were prepared by solidifying the molten wax in electric field. Samples were also prepared from the wax extraneous to the portion directly in between the electrodes. The highly purified variety of carnauba wax, *i.e*, the Prime yellow, showed distinct fibre structure. The other two varities showed fibre structure to a much less extent. In addition to the normal rings due to wax, certain other rings were also observed in certain patterns. A plausible explanation is given of all the experimental facts.

23. Etching of Mica

N. S. Pandya and J. R. Pandya, Baroda.

Muscovite mica is etched by hydrofluoric acid and for different times and the etch figures are observed by means of high resolution microscopy and multiple beam interferometry techniques. The depth and the orientations of the etch pits are determined. In addition to uniform etching of the surfaces with etch pits all oriented in the same direction, a few large etch pits randomly distributed but oriented the same way are recorded. These become larger and deeper in prolonged etching. There is no point to point resemblance on the two counterparts obtained by cleaving the same crystal.

In one case the larger etch pits are always in line which may be attributed to dislocation line. Mica surfaces examined were not found to show any special surface faults.

Cosmic Rays and Nuclear Physics

1. Pion-pion interaction in τ -meson decay.

A. N. Mitra, Aligarh.

The τ-meson has two alternative modes of decay, $\tau^+ \rightarrow \pi^+ + \pi^+ + \pi^-$ and $\tau^+ \rightarrow \pi^+ + \pi^0 + \pi^0$, in both of which the interaction between the pions emitted is expected to play an important part in determining the momentum distribution of these particles. The present investigation was undertaken with the object of studying the effect of a pion-pion interaction on (1) the momentum distribution of the emitted pions in charged τ-decay and (2) the branching ratio of the two alternative modes of τ-decay listed above. The interaction assumed is of the resonant type in an S-state of a two-meson system, so that the total isotopic spins allowed are $I = 0, 2$. It is found that the assumption $I = 0$ can explain only the feature (2), but its predictions do not at all agree with the experimental findings on (1). On the other hand, the assumption $I = 2$ explains both the features (1) and (2) very very satisfactorily.

2. On the Nucleon Antinucleon system.

R. P. Saxena, Aligarh.

Processes involving antinucleon annihilation have assumed importance in recent times. Since Born approximation is not reliable, it is of considerable importance to study this interaction more adequately. For kinetic energies small compared with the rest mass, the Tamm-Dancoff approximation has been found to be quite reliable from $\pi-p$ scattering data. The antinucleon interaction with matter is, therefore, studied in this approximation with a view to examining the modification which a departure from the Born approximation brings about in the annihilation processes. The formalism has been set up in the New Tamm-Dancoff approximation which lends itself to renormalization of the divergences in a completely covariant manner. The integral Eq. has, then, been separated out for the different cases of isotopic spin, spin, angular momentum, etc. The renormalization for the meson self-energy parts occurring due to infinite iterations of the annihilation process is in progress.

3. The Time-dependent Cascade Theory.

D. S. NARAYANA, Bombay.

The diffusion equations of one-dimentional time-dependent cascade theory of an air shower are set up and a solution for the moments of the functions satisfying the equations has been presented. From a knowledge of the moments and hence of the functions themselves, we can construct a picture of the instantaneous distribution of parttioles in an air shower. A brief report is made on the numerical calculations which are in progress.

4. The Abundance of Lithium, Beryllium and Boron Nuclei in the Primary Cosmic Radiation.

M. V. K. APPARAO, S. BISWAS, R. R. DANIEL, P. C. MATHUR, K. A. NEELAKANTAN AND PREM KUMAR, Bombay.

Charge spectrum of the heavy component of the Primary Cosmic Radiation has been obtained using a stack of nuclear emulsions exposed in the stratosphere in Texas, U.S.A. ($\lambda = 41°$) at a mean height of 112,000 ft. for $6\frac{1}{2}$ hrs. The stack was made up of G5 electron-sensitive emulsions and C2 emulsions A total of 602 particles of charge $>$ 3 has been obtained and their ionization estimated from grain counts in the various normally developed and under developed C2 emulsions and from δ-ray counts in the G5 emulsions. The ratio of the light group of nuclei (Li, Be, B) to the medium group of nuclei (C, N, O, F) has been obtained at the flight altitude. Extrapolation to the top of the atmosphere has been done from the zenith angle distribution of the particles of the two groups. By this method we have avoided the use of the controversial fragmentation probabilities used in conventional methods. The relative numbers of Li, Be and B observed indicate either that, at the top of the atmosphere, the light group of nuclei may almost entirely be due to Boron nuclei or that Boron nuclei are produced preferentially in collisions of heavy primary nuclei in the atmosphere. The implications of the above facts regarding the origin and history of cosmic rays have been discussed.

5. On the measurement of prehistoric cosmic ray intensity and oceanic sedimentation rates using cosmic ray produced Be^{10}.

D. P. KHARKAR, D. LAL, N. NARSAPPAYA AND B. PETERS, Bombay.

The measurement of prehistoric cosmic ray intensity involves the study of long lived isotopes produced by cosmic rays. The radio-isotope, C^{14}, has been used to determine cosmic ray intensity up to $\sim 10^4$ years. The recent discovery of another cosmic ray produced isotope, Be^{10} (half-life, 2·7 million years), in Pacific Ocean sediments, should now permit one to obtain prehistoric cosmic ray intensity for older periods.

In sediments which have been lying undisturbed, physically and chemically, the study of Be^{10} concentrations yield information, both on the cosmic ray intensity and sedimentation rates up to ~ 10 million years in the past.

The results of the analysis of Be^{10} in two Pacific Ocean sediments are discussed.

6. Cosmic ray produced isotopic changes in meteorites and their applications.

P. S. Goel, Bombay.

The production of various isotopes in meteorites due to their exposure to cosmic radiation in the inter planetary space is discussed.

Radio-isotopes with half-lives, ranging from a few years to a few million years can be detected with available techniques. Simultaneous determinations of these isotopes should provide information on the variation of cosmic ray intensity during the past 10 million years.

7. On the study of large scale air movements using cosmic ray produced isotopes.

P. S. Goel, N. Narsappaya, B. Peters,
Rama and P. K. Zutshi, Bombay.

The concentrations of the four cosmic ray produced isotopes, P^{32}, P^{33}, Be^{7} and S^{35} have been studied in rain water at four places in India, geographic latitudes 10–30°.

The half-life of these isotopes is of the same order as the time scale involved in certain meteorological processes. Their production by cosmic radiation varies strongly with latitude and altitude. The relative concentrations of these isotopes, therefore, depend strongly on the past trajectory of the air masses.

The measured concentrations of these isotopes suggest that they are efficiently scavenged from the atmosphere by wet condensations. Once an air mass is cleansed of its radioactivity by wet precipitation, the various activities build up again due to further irradiation by cosmic rays till the next condensation occurs. Our results are consistent with the interpretation that one mainly deals with air masses which spend about a fortnight in the troposphere between two successive precipitations.

8. On the clearing of emulsion plates.

Yog Prakash and I. S. Mitra, Aligarh.

A systematic study of the effect of the addition of Ammonium Chloride, Ammonium Hydroxide and Ammonium Sulphocyanide to Hypo bath of different concentrations has been made for different thicknesses of emulsions ranging from 5–10 microns (thin emulsions) to 200 microns and more (thick emulsions). The clearing time of the plates decreases as the concentration of Ammonium ion is increased in the Hypo bath and becomes constant after a particular value of the concentration of these salts. This decrease in time is depending on the thicknesses of the emulsion plates, being 50% in the case of thin photographic plates and about 20% in the case of 200 micron thick emulsion plates. The results obtained by the addition of Ammonium Chloride for thin emulsion plates have been found to be different than those reported by Piper, (Mees, pp. 523). A tentative explanation for the behaviour of these fixing baths has been given and optimum conditions for working have been obtained for different substances and for different thicknesses of plates.

The effect of these fixing baths on the developed grain size of thick emulsions has also been discussed.

9. Nature of the neutral particle in Jets.

PREM KUMAR, Hoshiarpur.

An interaction produced by a neutral particle has been observed in the core of a jet, initiated by a singly charged particle of the cosmic radiation. The energy of the neutral particle is estimated to be at least as much as that of the singly charged primary. This does not allow the assumption of its creation as a secondary meson from the first encounter. The neutral interaction is tentatively ascribed to have been produced by a neutron, accompanying the proton in the form of a deutron or a triton. Based upon 7 neutral interactions, known to us, and assuming the neutral particle to be a neutron, its mean free path for interaction is found to be 17^{+10}_{-5} cm., of emulsion. This value is incidentally the geometric mean free path for a nucleon radius of 1.1×10^{-13} cm, including the projectile.

A comparison of this m.f.p. has been made with the value for shower particles (a) mesons from proton initiated interactions and (b) mesons plus singly charged fragments from heavy primary induced stars. $= 37 \pm 8$ cm., from (a), and $= 28 \pm 6$ c.m., from (b), indicate the presence amongst fragments, of deutrons and tritons, the nucleons of which due to loose binding are liable to produce independent interactions. Implications of the results are discussed.

10. High energy interactions.

PREM KUMAR AND OM PARKASH, Hoshiarpur.

An interaction produced by a singly charged particle of the cosmic radiation has been observed in a stack of stripped nuclear emulsions, exposed in the stratosphere, at 19° geomagnetic north. The energy and the angular distribution of the mesons has been investigated in the C. M. System. The angular distribution is in fair accordance with an anisotropic distribution of the $\cos^2\theta$ type. The average energy of the mesons is 1 Gev. The energy of the primary in the laboratory system is found to be 1800 Gev. out of which 1000 Gev. is expected to have gone for meson production.

Another interaction between a heavy primary carbon nucleus and a hydrogen nucleus of the emulsion was observed in a stack of G5-G0 plates exposed at 55° north. The observed energy of the primary = 700 Gev. per nucleon is found insufficient to explain the production of 75 mesons in a single encounter The very high multiplicity and an isotropic angular distribution is attributed to have resulted from multiple meson-nucleon collisions.

11. Nuclear Quadrupole Vibrations and the calculation of Electric Quadrupole Moment of some closed shell plus (or minus) a single nucleon nuclei.

PARESH MUKHERJEE AND ILA DUTTA, Calcutta.

A critical survey has been made in this paper on the present position of the quadrupole moment of closed shell plus (or minus) a single nuleon nuclei. It is found that collective model formalism of the quadrupole moment is essentially correct, if one calculates the rigidity of the core from the data on the vibrational spectra of even-even

nuclei. Using the available data on vibrational levels the strength of surface coupling has been calculated and it is found that in the region of closed shell an intermediate coupling picture holds true. The values of the quadrupole moment are also improved in this scheme.

12. The Dependence on the Mode of Angular Momentum Coupling of the Elastic Scattering of High-Energy Electrons by some (1p)-shell Nuclei: Li^6, Li^7, N^{14}.

M. K. Pal and B. Dutta-Roy, Calcutta.

The role of angular momentum coupling in determining the elastic scattering form factors for high energy electrons is discussed for the nuclei L_i^6, L_i^7 and N^{14}. In this context various ground state wave functions have been employed—the LS-coupling wave functions, the intermediate coupling ground state wave-functions for L_i^6 and L_i^7 corresponding to the intermediate coupling parameter chosen to reproduce their energy level schemes, and the Ferrel and Visscher ground state wave-function for N^{14}. In view of these calculations an independent check is suggested for the Ferrel-Visscher wave-function from electron scattering experiments.

13. Elastic and Inelastic Scattering of High-Energy Electrons by Some Shell Nuclei on the Intermediate-Coupling Model: C^{12}.

M. K. Pal and M. A. Nagarajan, Calcutta.

The nuclear matrix elements of $1p$-nuclei for intermediate coupling, which have been worked out in a previous paper[1], are used here in the case C^{12} to calculate the elastic form factor and the inelastic form factor corresponding to the excitation of the nucleus to its 4.43 Mev. level. For the 7.65 Mev. level only the monopole transition matrix element has been calculated. The difficulty that has been faced in making a tentative 2+ assignment to the 9.61 Mev. level has been pointed out by discussing the observed magnitude of inelastic 4.43 Mev. scattering and position of the 15.09 Mev ($J = 1$, $T = 1$) level.

14. Radioactive decay of Eu^{15}.

S. K. Bhattacherjee, Shree Raman and

S. K. Mitra, Bombay.

The radioactive decay of Eu^{154} ($t_{\frac{1}{2}} = 16y$), obtained from thermal neutron irradiations of 95% enriched Eu^{153}, has been studied by using the Seigbahn-Slatis intermediate image spectrometer, a thin lens magnetic spectrometer and a coincidence scintillation spectrometer. In the decay to Gd^{154} there are four groups of β particles at maximum energies (kev) 1870, 900, 600 and 250. Besides, the following gamma-rays have been observed (kev), 123, 250, 344, 560, 710, 840, 970, 1235 and 1600. On the basis of gamma-gamma coincidences the following levels have been assigned to Gd^{154} (level energies in kev) 123, 371, 970, 1094, 1394 and 1734. The beta transition probabilities to these levels have been calculated from the known abundances of the beta-groups. The level structure of Gd^{154} will be discussed in the light of the Unified Nuclear Model.

15. On the Extra stability of isotope with N = 120.

R. K. GUPTA AND S. JHA, Bombay.

Electron capture decay energies measured in this laboratory have been utilised in beta -decay systematics in the region of platinum and mercury. The plot reveals the completion of a subshell at $N = 120$. It is suggested that it has its origin in the transition of atomic nuclei from spheroidal to spherical shape at $N = 120$.

16. Differential Elastic Scattering of Intermediate Energy Protons from Heavy Nuclei and the Optical Model of the Nucleus.

B. B. BALIGA, AND S. N. GHOSHAL, Calcutta,

An expression for the differential elastic scattering cross-sections for intermediate energy protons from heavy nuclei has been obtained employing Montroll-Greenberg approximation method and a complex nuclear potential well with a diffused boundary given by

$$\begin{aligned} V_n &= -(V_0 + iW_0) & \text{for } r < R_0 \\ &= -(V_0 + iW_0)\exp[(R_0 - r)/b] & \text{for } r > R_0 \end{aligned}$$

where R_0 is derived from the value of the nuclear radius. The Montroll-Greenberg approximation method gives results which are comparable in accuracy with the results obtained from calculations using the partial wave method. The potential employed is slightly different than that of Wood and Saxon, but has the advantage of involving much less elaborate calculations. For the coulomb scattering a surface charge distribution is assumed.

The calculated cross-sections for the scattering of 32 Mev protons from gold have been compared with the experimental ones. The agreement is obtained only in the middle region of the curve between angles 30° and 105°. For angles less than 30° the experimental points are lying above the calculated ones. This disagreement is probably due to the assumed surface charge distribution and since the charge scattering inside the nucleus is completely neglected. At large angles, again, the experimental points lie below the corresponding theoretical ones. By adjusting the diffusivity parameter an agreement can be obtained here too. Studies are in progress on the effect of the variation of the diffusivity parameter and the uniform volume distribution of the charge on the cross-section,

17. On the structure of uranium in thin film.

S. N. CHATTERJEE, Calcutta.

Thin film of Uranium was seen under the electron microscope at a magnification of 54,000 times and the electron diffraction pattern of the same was recorded. The analysis shows that Uranium assumes the β-phase structure in thin film.

18. On Relativistic Polarisation and Neutron Proton Scattering.

S. P. MISRA, Cuttack.

It is wellknown that the nuclear forces are best explained, at least in a qualitative manner, with the help of the pseudo-scalar meson theory. The purpose of this pape has been to consider the polarisation problem for nucleon nucleon scattering in this theory. Attempts have always been made to explain polarisation in case of scattering by expanding in terms of angular momentum and considering the scattering problem with the help of phase shifts in the different angular momentum and spin states. This procedure contains approximations in the solution of the scattering problem itself and also in the calculations of the phase shifts, of which only a few can be retained.

To avoid these sources of error, we have calculated polarisation in case of neutron-proton scattering by the use of the usual S-matrix, in the second and fourth orders. The cross-sections are expressed in terms of the large components alone and the Pauli spin matrices. It has been peculiarly observed that polarisation in case of such a scattering, when all the particles are initially unpolarised, is zero, which is in direct contradiction to experimental results. It is not clear, however, whether this is a general feature of the pseudoscalar theory.

19. The Two-Body Spin-Orbit Interaction

S. M. Vaidya, Bombay.

The effect of the inclusion of the two-body spin-orbit interaction is considered for the deuteron. It is found that the change necessary to be made in the strengths of the central and the tensor interactions is significant and is linear with the strength of the spin orbit interaction.

20. (n, ∝) and (n, p) reactions in Flourine.

E. Kondaiah, K. V. K. Iyengar and
C. Badrinathan, Bombay.

The ratio of the (n, α) to (n, p) cross-section in F^{19} has been experimentally measured for 14.5 Mev neutrons as 1.2 ; this ratio has been calculated, on the basis of compound nucleus formation, to be 3.5. Comparing the calculated value with the experimentally observed value, it has been concluded that either the continuum assumption is not valid in this particular case or direct interactions are playing a significant part, specially in the (n,*p*) reaction.

21, Corrections for distortion of observed beta-spectra.

M. C. Joshi, B. N. Subba Rao and
B. V. Thosar, Bombay.

Correction factors for window absorption have been determined and presented by means of an empirical formula. By means of this formula, it is posible to determine correction factors at any energy for window thicknesses within 1 mgm/cm , quite accurately. An empirical formula, which gives the relationship between cut off energy and window thickness in the same range, is derived.

Correction factors for backscattering from the backing of the source are presented in the form of curves. In the determination of these factors, electron energy up to 350 kev and backingthickness up to 2 mgm/cm^2 were considered. Durng these investigations, it was observed that backscattering is initiated only at a certain minimum thickness of the backing, depending on electron energy. Below this scatter initiating thickness, backscattering is negligible. An empirical relationship between the scatter-initiating thickness and electron energy is derived.

Correction factors determined by these methods have been applied to the beta-spectrum of pm^{147} which is known to have a straight line Fermi plot.

22. Alternating Current Polarography of Uranium.

A. K. SUNDARAM AND K. A. KHASGIWALE, Bombay.

Polarographic reduction of uranium in acid media has been studied by alternating current polarography at different frequencies, using Breyer and Gutman technique.

Uranium in weakly and moderately acid media gives two waves the first one corresponding to one electron reduction of U^{+6} and U^{+5} and the second to U^{+5} to U^{+3}. Two a.c. peaks are also observed corresponding to these reduction states. However, the peak heights are dependent upon the concentration of the supporting electrolyte of NaCl and HCl, the height increasing with increasing concentration.

In D.C. polarography disproportionation of U^{+5} to U^{+6} and U^{+4} is known to occur in high acid concentrations and increased with increasing concentrations of acid and also in the presence of complexing agents like oxalic acid. In 2M perchloric acid and 0.4M oxalic acid the disproportionation being almost complete, the first wave corresponds to a 2 electron reduction of U^{+6} to U^{+4}. It is, however, found in the a.c. study that the first wave does not increase either with acid concentration or oxalic acid concentration the constancy of the peak indicating that there is no disproportionation. Analytical aspects of the a.c. wave of uranium are under investigation.

23. Volumetric estimation of uranium in samples containing large quantities of thorium (Tri-Butyl Phosphate Extraction Procedure)

N. R. THAKOOR, L. M. MAHAJAN, M. S. VARDE
AND V. T. ATHAVALE, Bombay.

A method is described for the volumetric estimation of uranium in samples containing large amounts of thorium together with other interfering elements. The uranium is extracted with a 5% solution of T. B. P. in kerosene from a solution of the sample in 2N nitric acid. The extracts are stripped with water and then with ammonium carbonate solution, and the uranium determined by the usual volumetric method of titration with ceric sulphate solution after reduction in a Jone's reductor. The range of estimation is between 10 and 100 mg U_3O_8.

24. Polarographic estimation of soluble silica in uranyl nitrate.

M. SUNDARESAN, Bombay.

The estimation of soluble silica in uranyl nitrate is based on the polarographic reduction of the silicomolybdate complex. No chemical separations are involved and amounts as low as 2 P.P.M of soluble silica in uranyl nitrate can be estimated within an error of 10%. A study of interference by common cations showed that none of them except iron above 1.2 P.P.M. interfere seriously.

25. Adsorption of thorium on anion exchange resin from sulphate solution.

T. K. S. MURTHY, Bombay.

Thorium (Th^{+4}) is known to form complexes with SO^{-2}_4 ion in aqueous solution. Zebroski and others reported the presence of $[Th(SO_4)]^{+2}$ and $[Th(SO_4)_2]$ in sulphate solutions. In this laboratory, it has been observed that when thorium sulphate solution is passed through an anion exchange resin (Amberlite IRA-400) in the sulphate form, it is adsorbed effectively. This may indicate the presence in solution of anionic complexes not hitherto reported. However, a detailed study of the adsorption process revealed that the process can be explained as an addition reaction of the type $Th + 2SO^{-2}_4 + 2R = SO_4 \rightarrow R \equiv [Th(SO_4)_4]$ (where R = Resin Cation). This observation has been utilised for the separation of thorium from rare earths with which it is associated in monazite.

26. An Investigation on the Use of Very Low Doses of Radio-isotopes in clinical diagnosis with special arrangement of G. M. Counter.

FAZLE HOSAIN, Calcutta.

With the progress of the use of Radio-isotopes in medicine the author feels the necessity of reducing the doses still to a lower level, specially in cases of diagnosis. In therapeutic applications the optimum doses should be given ; the present diagnostic doses may prove the most hazardous agent as the same patient may not be a victim for diagnosis only once in his life. Work was started to lower the doses in diagnostic and metabolic tracer uses of Radio-isotopes in human beings by developing the detecting device. A windowless flow gas G.M. Counter has been set with an anticoincidence ring of 10 ordinary G.M. cosmic ray counters. The arrangement is now giving a background of 3.4 ± .2 counts per minute and has proved extremely suitable for low level low energy low quantity sample counting.

Already 24 cases of the determination of human blood volume have been done using iodine-131 tagged human serum albumin and 0.5-1 micro-curie has been found sufficient for the work against 10-50 micro curies as generally used. Iodine-131 has also been used in Thyroid functional tests for Hyper, Eu and Hypothyroid patients using/ 1-2 micro curies against 10-100 micro curies as the conventional Tracer dose. Work is now in progress with iodine -131, Iron-55, Sulphur-35 in different clinical problems with human beings and animals.

Geophysics, Ionosphere and Meteorology

1. Resolving Time of Scaling Circuits.

B. M. BANERJEE AND MISS S. CHOUDHURY, Calcutta.

The paper describes an arrangement for measurement of resolving time of pulse processing circuitry, such as scalers and amplitude discriminators utilized by Nuclear physicists. Data for Higinbotham type binary units, utilizing different tube types and for various values of the circuit components have been presented. Studies made with double and triple pulses, at points where resolution just begins to fail have been reported.

While the resolution depends upon various factors, including input pulse amplitude, the standard Higinbotham binary, utilizing 12AT7, 6AL5 tubes and 20KΩ anode resistors, provide a resolving time better than 0.6 microseconds for pulse pairs and 1.2 microseconds for triples. This performance is stable and is obtained without attendent demands for accuracy in component values and operating voltages.

2. Super standard radar propagation.

A. C. De, Dum Dum.

Meteorological factors for determining the conditions for super standard radar propagation have been reviewed. It has been seen that under suitable meteorological conditions, the radar horizon can be extended for beyond the optical horizon. From a knowledge of the temperature and humidity distribution in the lower troposphere (lowest 1 km.) the conditions for super refractions can be found out. Meteorological origin of super refraction conditions and the attenuation produced by the meteorological phenomena have been discussed. The work of the author and his collaborators about the super refraction conditions at Dum Dum Airport has also been mentioned.

3. Microwave determination of electron production and electron loss.

M. P. Madan, Lucknow.

The importance of microwave techniques as a tool for the study of the physics of an ionized plasma has increased considerably in the recent years. To obtain a precise picture of the plasma and to understand the physical processes behind it, one must be able to quantitatively determine the various fundamental properties. The present paper describes an experimental method for the determination of electron production and electron loss, both with or without a magnetic field. Without a magnetic field, the experimental equipment essentially consists of an S-band magnetron, and a TM_{010} mode cavity coupled to a specially designed vacuum system. The measurements are obtained with the help of a variable microwave pulse by observing the rate of growth of electron density. In the presence of a magnetic field, the plasma is contained in a quartz tube inserted axially in a TE_{111} -mode brass cavity which in turn is surrounded by a specially shaped electromagnet providing the magnetic field parallel to the axis of the tube. The experiment again consists of measuring the time for the growth of the plasma., *i.e.* the electron production—electron loss. The similar observation in a decaying plasma, when the source of ionization is not present, gives the information about the electron loss.

4. Preliminary studies of the Energy Spectrum of near Atmospherics over a frequency range from 3 to 15 kc/s.

B. A. P. Tantry and R. S. Srivastava, Varanasi.

In the present preliminary investigation, narrow band amplifiers tuned to different sets of frequencies lying within a range from 3 to 15 kc/s, were employed to obtain simultaneous responses of the individual atmospheric pulses of near origin. The sinuous wave-patterns, delineated on the oscillographic screens were focussed by suitable lenses on a photographic film wrapped round a rotating drum. Along with these wave-patterns, showing the amplifier responses of an atmospheric pulse on different frequencies, the waveform pattern of the same atmospheric pulse was also simultaneously recorded by employing an automatic atmospheric recorder. The distances of the sources of atmospherics were obtained from the time-intervals between the successive pulses reflected from the ionosphere. The study of the relative amplitude of the wave-patterns obtained from the amplifiers tuned to different sets of frequencies showed that for most of the atmospherics recorded near the source, the amplitude distribution had a maximum lying between 8 to 10 kc/s.

The low-frequency tuned amplifiers and the Automatic Atmospherics Recorder are very briefly described in the paper.

5. Waveforms of Atmospherics with superimposed pulses recorded with an Automatic Atmospheric Recorder.

B. A. P. TANTRY AND R. S. SRIVASTAVA, Varanasi.

The automatic atmospheric recorder constructed and used by the authors has been briefly described. Of the various types of superimposed pulses recorded with its help, the 'stepped pulses from a lightning source, superimposed on the waveform due to a different lightning discharge has not been observed by previous investigators. Superimposed pulses, reflected successively from the ionospher have been shown, where the superimposed pulses and the waveform on which they were superimposed, originate from two different lightning sources or from the same lightning discharge. The 'hook' components of Malan and Schonland have also been recorded.

6. Location of sources of atmospherics using D. F. technique.

M. W. CHIPLONKAR, M. S. HATTIANGADI AND T. A. RAJU, POONA.

With a view to locating the sources of atmospherics two instantaneous direction finding recording units have been designed, built and installed at Poona and Sangli, approximately 120 miles apart. The units are tuned to 175 kc/s band. The unit at Poona has been brought into operation since January 1957 for recording the direction without the sense of the approach of atmospherics. The recording of both the direction and sense of the approach of atmospherics was commenced since April 1957. While at Sangali the recording of direction and sense was commenced by the end of June 1957. At each station a photographic record of the direction and sense of approach is obtained on a continuously driven film for a period of two minutes at four fixed hours (0800, 1200, 1700, 2100 hrs I.S.T.) during the day. In this paper results of preliminary measurements obtained with these units are presented. In particular, they show that this year at Poona the activity of atmospherics (as represented by the number of centres of sources only, and not by the field-strength, nor by the rate of reception of atmospherics) was relatively large during the month of February and unusually low in the months of April, May and even June. During the period April to August a larger number of sources is located in the Eastern Zone (North to South through East) than in the Western Zone. The activity at Sangli during the month of August is higher than that in July and the sources are equally distributed around the station in August, but not in July. The results of some occasions of simultaneous recordings at the two stations, obtained during the months of July and August, are discussed.

7. Theoretical study of group height versus frequency curves for the lower ionosphere.

B. RAMACHANDRA RAO, AND B. V. KRISHNAMURTHY, Visakhapatnam.

Conventional ionospheric recorders record the group height variations of radio waves in the ionosphere with frequency in the range of 1 to 20 Mc/sec. Very little work, both experimental and theoretical, has been done on the *h′*–*f* curves for the frequencies below 1 Mc/sec due to difficulties on experimental technique and lack of sufficiently approximate methods for computing group heights in this range where the effect collision frequency cannot be neglected. Using the approximate formula developed by Gibbons and Rao for the calculation of group indices and group heights corresponding to this level, the authors have computed the theoretically expected *h′*–*f* curves for the Chapman–Mitra model, Jones-Mitra model for daytime and Parkinson's midnight models for both summer and winter seasons. All the curves were drawn for a latitude of and the frequency range of 50 kc to 500 kc/sec. The group height values obtained from the Jones-Mitra model agree with experimental values for 50 kc and 75 kc and hence this appears to be a plausible daytime model. For the winter months the diurnal variation of group height expected theoretically by using Jones-Mitra daytime model and Parkinsons midnight model agree fairly well with the results obtained at Cambridge at about 50 kc and also with the results obtained on 75 kc by the Pennsylvania group. Following Mitra in assuming a three fold increase of D region ionisation during flare, it is found from the theoretical *h′*–*f* curves that the group heights are expected to decrease, but so far the available experimental data show that there is no change in group heights at these frequencies during solar flare.

8. On the Variation in the Horizontal intensity of the Geomagnetic Field at Phalodi (Rajasthan, India) during the Solar Eclipse of June 30, 1954.

B. J. SRIVASTAVA AND N. SIVASANKARA SASTRI, Bombay.

Detailed analysis of hourly mean values of the horizontal force at Phalodi from June 26, 1954 to July 7, 1954, has been made with a view to isolating an eclipse effect, if any. It is seen that June 30, 1954—the day of the eclipse—was magnetically not very calm. As such, the eclipse effects could not be disjoined from the hourly values pertaining to the eclipse period.

All the bays and other big and small magnetic fluctuations (accidental or otherwise) have also been tabulated from the Phalodi H. F. magnetograms for the period June 22, 1954 to July 7, 1954, in respect of their time-extent and magnitude. The bivariate frequency table of these fluctuations is also presented. The fluctuations occurring during the period of the eclipse are studied in relation to the frequency table. Important statistical parameters of the series of the magnitudes of the fluctuations are compared with the individual fluctuations for the eclipse period and their mean.

A fall of 10γ in the horizontal force, appearing 16 minutes after the totality at Phalodi was a likely eclipse effect. But when all the fluctuations occurring during the control period are studied and a picture of the accidental oscillations of the geomagnetic field is formed, it becomes difficult to say that the drop of 10γ was definitely due to the eclipse.

9. Diurnal Variation of Microwave Field Strength Between Landour and Roorkee.

Rajendra Vikramsingh, M. N. Rao, Surender Singh, and S. Uda.

Using P.T.M. microwave transmitters and receivers in the 2000 Mc/sec region, the field measurements have been carried out from March 1957 to August 1957 between Landour and Roorkee.

The height of Landour is about 2296 meters above sea level and that of Roorkee about 264 meters above sea level. The distance between these terminals is 69 kilometers and is in the direct line of sight. At the distances of about 32 and 40 kilometers from Landour, there exist two peaks on Siwalik range, one being about 834 and the other about 670 meters above the sea level. But these peaks do not obstruct the direct line of sight.

The received signal power is measured by recording the automatic volume control voltage (AVC voltage) in the intermediate frequency amplifier. A recording amplifier is used to operate a chart recorder meter which is proportional to AVC voltage and is calibrated by a standard microwave signal generator.

Hourly median values of received signals are obtained from chart records. Typical examples of diurnal variations of hourly median values of signals are shown in both cases with vertical and horizontal polarization waves.

It is noted that the received signal increases in the evening, reaches its maximum value at about midnight or a little later, then decreases rather rapidly in the morning, and reaches its minimum value at about noon. It continues for a few hours and increases again in the evening. The phenomena may be closely related to the change of the atmospheric condition along the transmitting path.

10. Electromagnetic induction in a layered earth.

J. N. Gupta, Kharagpur.

The general expression for induced field components outside a horizontal three layered earth has been deduced theoretically. The expression thus obtained has been used to calculate the induced field components due to a vertical oscillating magnetic dipole on the surface of the earth. Two particular cases have been considered : (a) The first and the third layers are of the same conductivity and the difference in the conductivity $\Delta\sigma$ of the first & the second layer is small. The resulting total scalar magnetic potential has been broken up into two parts : (i) The potential due to two layer structure (which comes out to be the same as obtained by previous workers and hence not cosidered). (ii) The perturbation potential due to the presence of the third layer, which has been deduced in this paper, comes out to be

$$\phi = \frac{Mjw\mu\Delta\sigma}{16\pi}\int_{:h_2}^{\infty} Sdz$$

where M is the moment of the dipole and S the Sommerfelds integral, and μ the permeability which is same for all the three layers. (b) The first and the third layers are of the same conductivity being separated by an insulating medium. The perturbation potential in this case comes out to be

$$\phi = \frac{M}{4\pi j w \mu \sigma_1} \left[I_0 - aI_1 + \frac{a^2}{2!} I_2 - \frac{a^3}{3!} I_3 + \ldots\ldots \right]$$

where the value of I_0, I_1, I_2...have been derived in terms of Sommerfelds & Fosters integrals.

It is believed that the results may be useful in the interpretation of electromagnetic field data in geophysical exploration.

11. Frequency-dependence and thermal after-effects of electrical conductivity of black shale

S. Hayagriva Rao, Kharagpur.

Influence of frequency on the conductivity of black shales from Giridih, Bihar, and after-effects of heating have been studied over the frequency range 2.5 Kc./s. – 5.0 Kc./s. at intervals of 100cps

Conductivity σ_f is found to increase linearly with increase of frequency f in the range studied and can be generally represented by a formula of the type

$$\sigma_f = \sigma_0 + m.f.$$

m being a constant.

For studying the after-effects of heating the samples were heat-treated at 120°C. After such treatment the conductivity decreases to a cosiderable extent, but recovers with time t of storage. The recovery is nearly exponential and is best represented by a formula of the type

$$\sigma_t = C e^{\lambda_1 t} + \lambda_2 t^{\frac{1}{2}}$$

c_1 λ_1, λ_2 being constants at a particular frequency.

The after-effect is attributed to the distortion of the lattice due to loss of water of crystallisation which, as shown by differential thermal analysis, occurs at about 115°*C*.

12. Study of the intensity of cadmium (2288) line with concentration of cadmium in cadmium-clay mixture.

Prasanta Kumar Misra and
Braja Sunder Mohanty, Cuttack.

The percentage of an element from samples collected by geologists can be found out spectroscopically by various methods of quantitative photometry. Here the authors tried to find out a method of determination of concentration of Cadmium in Cadmium-Clay mixture by studying the variation of intensity of the Cadmium resonance line ($\lambda = 2288$ AU) with the help of arc spectrum. Samples were prepared by taking 5, 10, 20, 50 and 100 weight per cent of Cadmium in Cadmium-Clay mixture. Small quantities of the sample were fed to a carbon arc at current 2.8 amperes and voltage 48 volts across the electrodes. Exposures of 5 seconds were taken in a E_3 Quartz spectrograph using B_{20} Quarter size plates. The intensity of the line was measured by means of a Moll recording Microphotometer. A regular variation of intensity of the line with percentage of Cadmium in the sample was found. The authors suggest that such a method, with suitable improvements might serve the purpose of determining percentage of an element from Geological samples.

13. Homogeneous Nucleation and Free Energy of Supercooled water Droplets..

ASOKE KUMAR MUKHERJEE, Jodhpur.

The formation of ice crystals in the atmosphere near $-40°C$. in the absence of foreign nuclei is now recognized as a process involving homogeneous nucleation of supercooled water drops and not sublimation. Earlier literature in this field does not appear to reveal the relationship that subsists between the rate of homogeneous nucleation and the free energy of the water drops. From the expressions for the rate of formation of nuclei given by Turuball and Fisher and extended by McDonald, the author has shown that the above parameters are related to each other in the manner given by the following expression:

$$J = \frac{n^2 CA'vh^3}{(2\pi m)^{3/2} f_v f_r} e^{(\Delta E_0 - G - NF_c)/RT}$$

where J is the rate of homogeneous nucleation, n the number of droplets per unit volume, h, the Planet's constant ; k, the Boltzmann's constant ; f_v, the vibrational portion function of water; m, the mass of liquid molecule ; ΔE_0, the heat of vaporization ; G, the free energy ; N, the Avogadre number ' F_c, the free energy of formation of nucleus; C, the gas constant and T, the absolute temperature.

From the above equation the interesting fact emerges that the rate of homogeneous nucleation is exponentially related to the free energy of supercooled water droplets.

14. On the Forecasting of Violence of Nor'westers at Calcutta.

P. M. DAS, Kharagpur.

In an attempt to find a basis for the forecasting of the violence of Nor' westers at Calcutta, the peak wind gusts observed were analysed against the temperature drop accompanying the storms. The results so obtained indicate that it should be possible to forecast the peak wind gusts with fair amount of success if the minimum downrush temperatures accompanying the Norwester thunderstorms could be predicted accurately. Two methods of prediction for this parameter are discussed : the one due to Fawbush and Miller in which the saturation adiabat through the point of intersection of the wet-bulb curve and the 0^0 isotherm on an aerological diagram ,produced down to the surface and the surface temperature so obtained is taken as the downrush temperature; the other developed in this paper treating the saturation adiabat through the drybulb freezing point in the similar manner and applying certain corrections. It is observed that both these methods give an underestimate of the minimum downrush temperature in most cases. Of the two, the method developed in this paper appears to be more suitable for prediction purposes.

15. Breaking of the night-time E-layer under disturbed conditions.

M. N. RAO AND A. P. MITRA, New Delhi.

In this paper we attempt to explain the temporary cessation of the night-time echoes of low frequency radio waves such as those observed at the Pennsylvania State

University under (magnetically) disturbed conditions. It is an extension of the work reported by H. R. Peiffer and A. P. Mitra (1955) in that, it includes the background nocturnal ionization which was neglected in their work.

It is shown that under conditions of enhanced vertical transports the night-time *E*-layer will 'break' for certain low frequency radio waves a few hours after sunset. The layer will then reform itself during the interval when the drift velocity is downwards. Values are given for the times of breaking, times of reformation and duration of breaking for waves of different frequencies and the relationship between magnetic K index and vertical ionic drift velocity in the *E*-layer. A special case of a layer of constant height of maximum ionization has also been worked out and the results are reported for comparison.

Astronomy Astrophysics

1. Non-stationary diffusion of imprisoned radiation from a gas.

Santi Ranjan Das Gupta, Calcutta.

We consider a slab of gas whose optical thickness τ varies from 0 to $2\tau_1$. Light from an external source illuminates the side $\tau = 2\tau_1$, for a length of time $(-0,0,0)$ sufficient to establish a steady state of the excited gas—which is assumed to be one of radiative equilibrium. After the steady state has been reached the source of illumination is suddenly cut off at time $t = 0$. But the excited atoms of the gas will continue to emit radiation while decaying with a certain mean life. In the present paper we find an approximate law of decay of the emergent intensity $I(t, 0, \mu)$ of this non-stationary radiation field in the gas.

In the first approximation we assume that $I(t, 0, \mu)$ is separable in the variables t and μ and decays exponentially with time. The second approximation is then obtained by a sort of limiting process. The method applied is the method of Laplace transformations combined with the technique of analytic continuation.

The equation appropriate to the problem is given by Chandrasekhar (Radiative Transfer, Oxford, 1950, eq. 69, 70, p356). The emergent intensity of the non-stationary radiation in the gas as obtained here is now given by

$$I\,(t, 0, \mu) = CH\,(\mu)\,.\,[1 + \lambda < 1 - \lambda\psi\,(\mu) > .\,t].\,e^{-\lambda t}$$

$$J\,(t, \tau)_{asymp.} \sim C\,.\,\{[F_1\,(\tau) - \lambda^2F_2(\tau)] + \lambda(1-\lambda).\,[F_1(\tau) - \lambda F_2(\tau)].t\}.\,e^{-\lambda t}$$

where $F_1\,(\tau)$ and $F_2\,(\tau)$ are determined functions of τ. And $H(\mu)$ gives the law of darkening for conservative grey scattering in the outer layer of a star.

$$\lambda = \left\{ \frac{C.\,F_1(2\tau_1) - J^0}{C\,F_2(2\tau_1)} \right\}^{\frac{1}{2}},\ C, \text{ being determined from boundary conditions.}$$

$$\psi(\mu) = -(9/5) + 3\mu^2 + \int_0^1 \frac{1}{\left(1 - \frac{1}{2}x.\,\ln\frac{1+x}{1-x}\right)^2 + (\pi.\,x/2)^2}\,.\,\frac{dx}{x+z}$$

$$J^0 = J(0+, 2\tau_1) = J(0-, 2\tau_1).$$

All the above functions are defined for the entire complex plane.

2. Polarization measures of cometary nuclei.

M. K. VAINU BAPPU AND S. D. SINVHAL, Naini Tal.

Polarization measures of the nuclei Comet Arend-Roland, 1956h, and Comet Mrkos, have been carried out photoelectrically. The observations were made through interference filters that transmitted the Swan bands, Sodium D-lines and the continuum, as well as through standard B, V, filters of the Johnson-Morgan U, B, V, system. In the case of Comet Arend-Roland the emission was weak relative to the continuum and gave a mean value of 20% polarization at a phase angle of 90°. The nucleus had a colour equivalent to that of a K2 *V* star. The colour and observed positive polarization of twenty per cent may be explained if one assumes particles of size 0.4 microns and refractive index or in the range 2.0-3.0 or alternatively of diameter 4.4 microns and refractive index 1.2. The polarization results obtained in the case of Comet Mrkos are identical with that of Comet Arend-Roland, except that a high value of polarization was obtained through the 5890A filter on the nights of August 19 and August 20, 1957, indicating the presence of Sodium resonance radiation.

3. Focussing of solar ion streams in the presence of magnetic field.

J. N. TANDON, New Delhi.

The ion streams emerging from various solar regions are known to produce geomagnetic storms and aurorae. Various features of the geomagnetic storm associated with solar regions e.g. sunspots, chromospheric erruptions, coronal regions, etc., are qualitatively explained from the focussing of solar-ion streams taking account of the local and general solar magnetic field. It is found that the streams emerging from the solar regions of large magnetic field may get dispersed while they may come out in the form of concentrated streams from quiet solar regions which do not possess large magnetic fields. Further, qualitative explanations for the formation of coronal plumes near the sunspots and of coronal streamers around the sunspot minima have also been given.

4. Ancient determination of seasons and Tiruvadurai Festival at Chidambaram (Madras).

S. L. MALURKAR, Bombay.

When man became dependent on cultivation, the operations like ploughing, showing, reaping, etc., assumed considerable importance. To conserve his seeds, to save his labour and to get the best crops, the agriculturist needed advance knowledge of the seasons entailing a study of the sun's position or of a solar calendar. Those that satisfied this need would be very useful members of the society. The position of the moon which is visible along with the stars on most nights could be easily noted, while that of the sun involved observation, interpolation and deduction. In ancient Egypt, as till recently the farmer depended on the Nile river flooding and irrigating his fields even while the sky over him was practically cloudless. The Nile floods depended on the seasonal rainfall in the more southern high lands of tropical Africa. The Egyptian priests had observed that the heliacal rising of Sirius (α Canis Majoris) was followed by these floods. They deduced the length of the tropical year and the epochs of equinoxes. Two thousand years ago, the Indians along the coasts had trade relations with other known nations and assimilated the knowledge gained from the foreigners into their own culture. The heliacal setting and rising of Sirius can not be easily observed in S. India or even in N. E. India as the sky gets clouded up being the eve or the onset of the S. W. monsoon.

In Kerala, Tamilnad and higher up along the east coast in Bengal, the purely solar year has had a long vogue. Over the rest of India, the calendar has been luni-solar *i.e.* based on twelve lunar months with an intercalary month added every few years and very occasionally subtracted for adjustment with a tropical year i.e. to keep track of seasons. The position of the sun is determined if the time of full moon and the corresponding lunar constellation be known. While there is evidence of sun's position being observed almost directly, the intermediary of the full moon's position has apparently been often used.

A lunar constellation near Sirius with the bright star Betelguese (α Orionis) is Ardra. The full moon is near this constellation in December (Dhanus, Tamil, Marghali, luni-solar Margashira or Pushya). Within a day of the epoch of the full moon, the moon would actually be or have been in Ardra. On that day in the morning a ceremonial of Ardra Darshanam (viewing of Ardra) is observed at the Nataraja temple at Chidambaram (Madras) with an important festivity of Tiruvadurai. Tiru is an honorofic term added to many tamil words. Sirius is known in India as Vyadha. The period of of the festival is almost exactly six months away from the ancient Egyptian on because the intermediary of the full moon's observation instead of the sun. The importance of the festival indicates a bearing on the community's life *i.e.* food. These suggest that 'tiruvadurai' might be a corruption of Vyadha and that the observation is analogous to that of the ancient Egyptians. The important observation was followed by an elaborate ritual as in ancient countries of the Middle East. The joy and the emotional release felt at the time might be portrayed sculpturally.

The knowledge of celestial viewing and deductions of a 'cosmical ordering' were perhaps part of the "rahasya" which could be comprehended by a select few only.

SECTION OF CHEMISTRY

President :—PROFESSOR S. GHOSH, D.Sc., F.R.I.C., F.N.I., F.N.A.Sc.

Abstracts

PHYSICAL CHEMISTRY

1. Heat of Activation During Gel Formation

S. K. BOSE, S. P. MUSHRAN and S. GHOSH, Allahabad.

Succinate gels of iron and aluminium are obtained by the interaction of the metal chloride and sodium succinate. Heat of activation has been calculated assuming gelation a simple chemical reaction. In such metathetical processes the heat of activation for the gelation process decreases with the increasing amount of the metal chloride left free in the system but the rate of gelation is decreased. It is argued that the probability factor, P, becomes small which necessarily affect the gelation rate. Hence the approach of the colloidal units only along a particular axis may lead to their aggregation, and these are the spots least covered by the ions so that the repulsion be the least.

Further, the tendency of free energy on the surface is to decrease leading to their growth. Smaller particles have greater surface energy and hence have greater tendency to grow though it is opposed by their electric charge. Hence particles need not require large energy of activation for their aggregation. Therefore, when sodium succinate is added to the metal chloride to near about the equivalent amount, the insoluble substance has lesser amount of peptising agent (the metallic ions) and has grown big which require larger activation energy for their gelation.

2. The preparation of transparent gels of ferric adipate and the increase in consistency of ferric adipate sols.

R. P. AGARWAL and S. P. MUSHRAN, Allahabad.

Sodium adipate and ferric chloride solutions interact to give a reddish brown, highly hydrated, precipitate of ferric adipate. It is observed that in presence of excess of ferric chloride the precipitated ferric adipate gradually dissolves on shaking. A deep red coloured sol of ferric adipate is thereby obtained. The sol is subjected to dialysis at room temperature. The pure dialysed sol when coagulated with a potassium sulphate solution of suitable concentration gives stable gels with glass like transparency. The rheological study of the undialysed sol indicates that it is Newtonian in behaviour. During dialysis, when the sol has attained sufficient purity, it gains non-Newtonian characteristics indicating the development of stucturations in the sol The sol gets quickly aged within a few days and shows a remarkable increase in consistency during the process of ageing. The aged sol requires lesser amounts of potassium sulphate to produce gelation in a definite time which conclusively indicates an increase in the stucturations in the sol with age. Further it has been observed that physical factors like shaking have a remarkable effect on gelation. The dialysed sol was slowly shaken in a shaker for about 20 minutes and then left undisturbed. It was observed that the sol set to a transparent gel in the course of a few hours. The ferric adipate sol has therefore the property of increasing in consistency more rapidly with slow stirring than at complete rest.

3. Conductometric and electrometric studies of aluminium succinates.

S. K. BOSE and S. P. MUSHRAN, Allahabad.

Aluminium chloride and sodium succinate solutions interact to give a gelatinous precipitate, and at suitable concentrations produce a firm and stable gel. Here we have investigated the precipitation effected by the progressive addition of sodium succinate to an aluminium chloride solution of different dilutions. The conductivity graphs show a sharp increase in the beginning followed by a curvilinear rise till the equivalent point where a break occurs and then the conductance rapidly rises. At the initial stage the free acid from the aluminium chloride interacts with the succinate solution, and sodium ions replace the aluminium ions. The latter reaction being more pronounced the conductivity rises very sharply. Afterwards formation of aluminium succinate and adsorption of hydroxonium ions become significant and so the conductance follows a curvilinear path till the reactants are in equivalent amounts, after which complete precipitation of aluminium succinate is observed.

The pH variation shows a gradual rise and is bilogarithmic in nature. The initial rise in pH clearly indicates the rapid removal of hydroxonium ions from the medium, and the subsequent variations are not so prominent till the equivalent point is reached where the inflexion occurs.

4. The preparation of zirconium adipate gels.

R. P. AGARWAL and S. P. MUSHRAN, Allahabad.

Sodium adipate and zirconium nitrate solutions interact to give a white gelatinous precipitate of zirconium adipate. If a slight excess of zirconium nitrate is present the white precipitate of zirconium adipate first formed dissolves on shaking and a clear colourless sol is obtained. The excess of zirconium nitrate thus acts as a peptising agent. The sol is, however, quite unstable and a gradual increase in turbidity and viscosity of the sol with time is observed and in the course of a few hours it sets to a firm and nonsyneretic gel. It has been observed that gelling time decreases with an increase in concentration of sodium adipate and increases with an increase in concentration of zirconium nitrate. Further with the increase in temperature the gelling time has been found to decrease. Freshly prepared gels are slightly opalescent due to the marked tendency of the dispersed phase to separate out. With the process of ageing the turbidity increases indicating a further slow growth of the gel particles forming probably more anisotropic aggregates. It is interesting to note that stable gels can be obtained only in a very narrow range of concentration of the interacting solutions. Higher concentrations yield precipitates or opaque gels due to the rapid precipitation of the dispersed phase and very low concentrations yield loose and less viscous gels.

5. Stability of the sol of Hydrous ferric Oxide.

DILAWAR SINGH and SATYESHWAR GHOSH, Allahabad.

The paper deals with the composition of colloidal micelles of different grain sizes. The results show that the association of the anion with the hydrous oxide is related to the size of the colloidal micelles. It has also been shown that the electrical conductivity of the colloidal micelles rapidly increases with the decrease in the size of the colloidal particles. It is concluded that the colloidal hydrous ferric oxide tends to behave as colloidal electrolyte when the grain size is very small.

It is found that hydrogen ions imparting electric charge increase with the decrease in the size of the colloidal grains and it is so because more surface is available for adsorption from smaller size colloidal particles than from bigger ones. The results presented here, conclusively prove that the colloidal micelles carry with them both negative and positive charged ions and the excess of one over the other determines the net electric charge on the smaller size colloidal micelles that they are more stable for electrolytes. This behaviour is, however, more prominent for monovalent than for the polyvalent anions.

The amount of chloride associated on the colloidal micelle is a function of the surface of the micelles and is associated with colloidal micelles in order to neutralise the growing charge by the adsorption of Hydrogen ions of the colloidal micelles, and, therefore, the association of anions is not due to the formation of any definite complex compound with hydrous ferric oxide particles as postulated by others.

6. Studies on hydrous thorium oxide. Part I. Observations on the precipitation of the hydrous oxide from thorium chloride solutions.

RAMESHWAR PRASAD and ARUN K. DEY, Allahabad.

The precipitation of hydrous thorium oxide, from thorium chloride solution by sodium hydroxide, has been studied. It has been observed that from a 0·0625M solution of thorium chloride, complete precipitation occurs when 2·8 equivalents of alkali have been added. With increase of dilution, the precipitation value tends to increase. Temperature has no marked effect on the precipitation values. In the presence of added foreign electrolytes, like NaCl, KCl and K_2SO_4, the precipitation requires more of alkali.

These results support the observations made in these laboratories, on other hydrous oxides, and are in accordance with the hypothesis of hydrolytic adsorption in such precipitation reactions, as advanced earlier.

7. Adsorption of crystal violet on hydrous cromium oxide.

RAJESH BEHARI HAJELA and SATYESHWAR GHOSH, Allahabad.

It is well known that acid dyes containing coloured anions viz. Alizarin is taken up by hydrous oxides of aluminium, chromium, iron etc., whilst a basic dye as Methylene Blue is taken up by acidic hydrous oxide as silica.

It is noted that basic dye Crystal Violet solution is a good adsorbate for Hydrous Chromium Oxide prepared under suitable conditions. Ghosh and coworkers, in their previous papers, have observed hydrous oxide of chromium precipitated in the excess of caustic soda solution is capable of adsorbing cations and develop acidic properties.

The adsorption isotherms obtained have inflections, increasing with increasing temperature and time and has been found to be irreversible. The adsorption curve indicates that :

1. The adsorption isotherm in initial stages is convex towards *X*-axis showing that the heat of adsorption is smaller than the heat of dissolution of Crystal Violet.
2. The nature of adsorption isotherm shows multimolecular layer adsorbed on the surface of adsorbent.

8. Catalytic activity of hydrous nickel oxide as related to its adsorptive capacity and dependence upon its mode of preparation.

MIRZA AIJAZ BEG and S. GHOSH, Aligarh and Allahabad.

Hydrous nickel oxide precipitates by deficient, equivalent, and excess of alkali showed difference in its adsorptive capacity for potassium iodate and catalytic activity in this decomposition of hydrogen peroxide. The sample which is a better adsorbent is also a better catalyst. The adsorptive capacity as well as the catalytic activity of the hydrous nickel oxide falls with its ageing. The formation of intermediate adsorption compound in the heterogeneous catalysis has been proposed.

9. Behaviour of ammonium aurintricarboxylate as a colloidal electrolyte.

ANIL K. MUKHERJI and ARUN K. DEY, Allahabad.

While studying metal chelates involving ammonium aurintricarboxylate, it was realized that physicochemical methods often give such compositions of the chelates, which are divergent from true stoichiometric ratios. It has been concluded from electrical conductance studies, that the reagent behaves as a colloidal electrolyte, but when in dilute solutions it is predominantly in true solution. It has been emphasized that for the determination of the composition of chelates involving such chelating agents, by physico-chemical methods, it is advisable to work with extremely dilute solutions.

10. Sodium alizarin—3—sulphonate as a colloidal electrolyte.

ANIL K. MUKHERJI and ARUN K. DEY, Allahabad.

During the study of the composition of metal chelates of sodium alizarin-3-sulphonate, it was realised that the colloidal nature of the reagent, especially in concentrated solutions, masks the true composition of the chelate. An investigation of the electrical conductance at various dilutions and temperatures shows that the reagent belongs to the class of colloidal electrolytes. The plot of equivalent conductivity against the square root of concentration gives a curve, which is not linear. This shows that the Debye-Hückel equation is not applicable. At lower dilutions, the reagent has a tendency to behave as an electrolyte.

11. Nickel ferricyanide gel Part I—Its time of setting.

S. ANWAR ALI and WAHID-U-MALIK, Aligarh.

The systematic study of the time setting of the Nickel Ferricyanide Gel leads us to the following conclusions :—

(1) The time of setting has been found to depend on the concentrations of the reactants used to form the Gel. It was observed that the time of setting is longer for the higher concentrations (1·1N) than for the lower concentration (0·8N) of Nickel chloride.

(2) The time of gelation slowly increases with the molar ratios of the reactants from 1·0 : 1·0 to 1·0 : 1·3 and after that increase in time is more rapid. The curves show a tendency to become parallel to the time axis at the ratio 1·0 : 1·5 of $NiCl_2$ and K_3FeCy_6 suggesting that the ratio of the reactants becomes independent of the time of gelation beyond the value 1·0 : 1·5 of $NiCl_2$ and K_3FeCy_6. The result is confirmed by our observations that Nickel Ferricyanide gel is not obtained when $NiCl_2$ and K_3FeCy_6 are mixed in a ratio greater than 1·0 : 1·5.

12. Nickel Ferricyanide gel, Part II, Conductivity changes during dialysis.

S. ANWAR ALI and WAHID-U-MALIK, Aligarh.

The study of the precipitated Nickel Ferricyanide when they are converted into gels on prolonged dialysis presents the following points :—

(1) The concentration of the reactants play an important part in the formation of jellies prepared by dialysis. The time of setting of the jellies slightly increases

with the period of dialysis showing that the coagulating effect is more pronounced than the hydration factor.

(2) The conductivity was found to decrease with the time of dialysis and in certain cases a very low decrease was observed. This is only due to the removal of ions during dialysis.

(3) Since gel formation is possible on dialysing the precipitate for a short period, steady values of conductance can be expected, but it is not evident as to why in the later steps of dialysis appreciable changes in conductance are observed even though the dialysed sample sets to a gel.

13. Studies in Inorganic Polyelectrolytes—I, Graham's salt: Dependence of Molecular Weight on the Conditions of Formation.

A. C. CHATTERJI and HARIHAR NATH BHARGAVA, Lucknow.

Nearly seventy samples of Graham's salt were prepared by heating Sodium dihydrogen phosphate under varying conditions and chilling the melt. Their molecular weights, determined according to Strauss by measuring intrinsic viscosity in 0·035N NaBr solution were found to depend on the conditions of formation, e.g. the nature of the surface of the vessel in which the melt prepared, and the temperature of the melt. End-group molecular weights of many samples were also calculated and an attempt has been made to correlate them with the weight-average molecular weights. Modification of an empirical formula of Strauss giving molecular weights by a single determination of specific viscosity in water, has also been suggested.

14. Antagonistic effect of mixed emulsifying agents.

L. N. MUKHERJEE and J. P. BARTHWAL, Lucknow.

In this paper effect of varying concentrations of aluminium hydroxide and bentonite which are good emulsifying agents is seen on M/50 sodium oleate which is highly colloidal solution. Similarly 0·1 per cent each of lamp black or rosin which are good emulsifiers of water-in-oil types their effect on sodium oleate aluminium hydroxide and bentonite as mixed agents was seen.

By means of size frequency analysis these emulsions have been studied as by King and Mukerjee, distribution of their globules were measured immediately and at different intervals of time. The total area of interface of per gm. oil is calculated for each emulsion at different intervals of time and found to decrease linearly with time. In the present work we have seen that the initially fine sodium oleate stabilised emulsions tend to become coarser when aluminium hydroxide or bentonite, the two solid emulsifying agents are added in different quantities. It was further seen that up to a certain concentration of the mixed agents the stability decreases, but with higher concentrations of the mixed agents there is a rise in stability factor and this enhancement in stability is certainly due to the greater adsorption of solids compared to the colloidally dispersed sodium oleate. As it was seen that with 0·1, 0·25 and 0·5 per cent of aluminium hydroxide added as mixed agents to M/50 sodium oleate, the emulsion formed shows a gradual decrease in interfacial area and stability with the separation of oil increasing. But with 0·75 and 1 per cent of aluminium hydroxide added as mixed agents the smaller globules disappeared with the appearance of bigger globules in higher percentage and coarse emulsions were formed. But these emulsions formed were very stable. There was no oil separation ever. These emulsions are very similar to the aluminium hydroxide stabilised emulsion of Mukerjee and Srivastava, but having a slightly higher stability. This enhancement of stabilities is certainly due to the greater adsorption of the solids compared to the colloidally dispersed sodium oleate. Similar observations were also noticed in the case of sodium oleate and bentonite emulsion. But the emulsions with 0·1, 0·25 and 0·5 per cent of bentonite on the whole were better than the corresponding aluminium hydroxide emulsion. With 0·75 and 1·0 per cent of bentonite small globules were still in higher percentage and these emulsions had lesser stability factor than the corresponding aluminium hydroxide stabilised emulsions. It may be due to the difference in the chemical structure of the two agents. These observations are very interesting and attempts are being made to connect all these changes with interfacial tension adsorption and wetting of the agents. Lastly the effect of 0·1 per cent each of lamp black or rosin as mixed agents on sodium oleate, aluminium hydroxide and bentonite is seen. As is clear that in spite of the greater interfacial areas except in the case of sodium oleate, stability of the emulsion promoted decreases because of the adverse emulsifying nature of the two mixed agents. It was also seen that when both agents are present the phase type depended on their relative concentration as in the case of soap stabilised emulsion with lamp black, there is a zone of stability between 0·5 to 0·75 per cent and beyond this range water-in-oil emulsions were produced.

15. Determination of pore size distribution of solid catalysts.

M. V. C. SASTRI and N. N. BANERJI, Kharagpur.

The knowledge of the pore size distribution of a solid catalyst helps investigating the role of diffusion in a given catalytic reaction. The rate at which reactant gases are transported to the inner surface of the catalyst pellet and the rate at which the products come out of the inner surface are closely related to the pore size.

The distribution of pore diameters in the range 10A° to 200A° is usually determined by the application of the Kelvin equation, with suitable modifications, to the desorption isotherm of a capillary condensate, usually nitrogen, at its boiling point. Two mathematical procedures have so far been used for the computation of pore size distribution. The first one, proposed by Shull in 1948, is based on the tacit assumption that the pore size distribution follows standard distribution patterns of either the Maxwellian or the Gaussian types, or a combination of both. Thus by comparing the curve plotted from the experimental data with the standard ones, certain parameters are determined which govern the pore size distribution. The second method, put forth by Barrett, Joyner and Halenda in 1951, is more direct in the sense that it does not assume any particular set pattern of distribution. The desorpion isotherm is analysed stepwise, whereby the volume contained in pores, whose radii lie within a fixed range, is obtained.

Both these methods are admittedly tedious and time consuming and, between themselves, they lead to quite different patterns of pore size distribution. Recently a new method has been suggested by Wheeler involving a graphical integration with the help of a planimeter, thereby saving considerable time and tedium of operations. This method has been tested here for a few adsorbents with the help of data collected from literature. The results show a fairly good agreement with those computed by the B.J.H. method. The only difficulty noticed in this method is that its use is restricted to a limited pore size range (pore radius from 15A° to 80A°). It is being endeavoured to extend the applicability of this method to a wider range of pore sizes.

16. The influence of a chemisorbed layer of carbon monoxide on subsequent physical adsorption.

M. V. C. SASTRI, T. S. VISWANATHAN and T. S. NAGARJUNAN,
Kharagpur.

The extent of the metallic component on the surface of iron, cobalt and nickel catalysts is estimated by the chemisorption of carbon monoxide at liquid nitrogen temperature. The methods suggested by Emmett and by Anderson for estimation of the amount of carbon monoxide chemisorbed involve the following assumptions:

(a) Evacuation at –78°C does not remove any part of the chemisorbed carbon monoxide.

(b) the physical adsorption over bare surface is the same as that over a chemisorbed film of CO.

The present investigations were undertaken to ascertain the validity of these assumptions in the case of cobalt catalysts.

The catalyst used was of the following composition CO : ThO_2 : Kg = 100 : 18 : 200. The adsorption experiments were carried out in a conventional volumetric adsorption apparatus. After CO adsorption at –194°C, evacuation at –122°C or at –78°C, left behind a film of chemisorbed CO. Over this film subsequent adsorption isotherms of CO and N_2 were determined.

The results obtained showed that (1) a part of the chemisorbed gas is removed during evacuation at –78°C thus suggesting the presence of two types of chemisorption over the surface, differentiated by the relative strength of binding, (2) the strongly chemisorbed CO, resisting desorption at –78°C, suppresses the subsequent adsorption and (3) the weakly chemisorbed CO had on the contrary little effect on the subsequent physical adsorption.

The results are interpreted on the basis of the presence of an electric double layer due to chemisorption, which brings down the induced polarization of an approaching N_2 or CO molecule, thereby causing suppression. It is pointed out that extent of suppression cannot strictly be estimated by measuring the physical adsorption of N_2 over the chemisorbed CO film since the suppression of CO physical adsorption, may not be the same as that of N_2 physical adsorption.

The physical adsorption of CO over the chemisorbed CO layer cannot therefore be equated to the adsorption of N_2 over the bare metal surface at the same temperature as implied in Anderson's method. It is concluded that the method originally suggested by Emmett is theoretically more sound and should yield accurate results if a temperature much lower than –78°C (say –122°C) is used for desorbing only the physically adsorbed gas.

17. A new explanation for the adsorption isotherms of association colloids.

N. H. SIVARAMAKRISHNAN and ROBERT D. VOLD, Bangalore.

Adsorption isotherms have been determined employing highly purified samples (ash content 0·2% and 0·017%) of sterling NS carbon and aqueous solutions of purified sodiumdodecyl sulphate. Even in this case it has been noticed that after the critical micellar concentration there is an abrupt increase in the adsorption of sodiumdodecyl sulphate. With further increase in the concentration of the sodiumdodecyl sulphate the isotherm reaches a maximum and falls off. The theories to explain this effect have been reviewed and a new explanation has been offered for the entire course of the curve. In this explanation it is assumed that desorption of both single ions and surface micelles occurs on collision between the adsorbing surface and micelles in solution in addition to previously established processes of adsorption and desorption of single molecules or ions and adsorption of whole micelles.

18. Chemisorption of carbon monoxide on cobalt powder.

V. SRINIVASAN and K. R. KRISHNASWAMI, Bangalore.

The adsorption of carbon monoxide on three samples of pure cobalt powder was investigated in the temperature range –191° to 97°C. The adsorption showed a maximum at 0°. The chemisorption of carbon monoxide at 0° and above, where physical adsorption of carbon monoxide is negligible, corresponds to more than a monolayer in volume thus indicating the occurrence of some other process besides chemisorption of carbon monoxide. Investigations indicated that no carbonyl of cobalt, unlike as in the case of nickel, is formed in the range 0° to 97°C. It was however clearly established that carbondioxide was formed even during adsorption at 0°, by examination of the desorbed gas at the same temperature, viz. 0°C. It was also possible to regenerate the original surface of cobalt by hydrogenation at 300° and degassing, as indicated by the reproducibility of hydrogen isotherms as well as the surface areas of the samples. The mechanism of formation of carbondioxide during the adsorption of carbon monoxide by cobalt has been discussed in the paper.

19. Fractionation of Kaolin into different sizes by Application of Electric Field.

M. M. BISWAS, Calcutta.

An imported variety of light kaolin was first of all purified by treatment with acid and alkali. It was further purified by an electro-osmotic method using carbon anodes and copper cathodes. A 5% suspension of this purified stuff was subjected to a process of electrophoresis in a specially constructed apparatus using carbon electrodes, the anode being fixed at the top of the suspension and the cathode at the bottom. An electric field of 80 volts D.C. and 0·1 ampere current was applied for one hour. Fractions from the four chambers of the column were tapped off by stop-cocks fitted at the bottom of each chamber at equidistant points on the vertical surface of the column. After electro-phoresis the fraction from the 1st chamber was found to possess a concentration of kaolin particles of 10 microns and 3 microns diameter falling within the limit of the British Pharmacopoeia whereas the fractions from the 2nd, 3rd and 4th chambers as also the original suspension of kaolin failed to attain the above limit.

20. Cation exchange in homoionic clay salts at several concentrations (lower and higher than the symmetry concentration) of the added electrolytes. Features of exchange isotherms.

S. K. NANDI, Calcutta.

Symmetry values i.e., the amounts of cation exchanged at a particular concentration (symmetry concentration or an amount equivalent to the total amount of the exchangeable cation present in the clay) of the added electrolytes, which is a single point on the exchange isotherm have been studied in part I of this series. Cation exchange at several concentrations, lower and higher than the symmetry concentration, of different electrolytes have been studied in the present paper, using monovalent and bivalent clay salts. The graphs have the form of the usual exchange isotherms, in which the lyotrope effect is clearly indicated. A greater replacing effect of bivalent than monovalent cations is quite evident from the steeper slopes of both bivalent and monovalent clays. The closeness of the graphs for bivalent clay against bivalent cation and monovalent clay against monovalent cation indicates that the relative replacing powers of the bivalent cation pair on the one hand, and of the monovalent cation pair on the other, are more or less at par with each other.

21. A comparative study of the base exchange equations of Ganssen, Jenny and Bray in the light of the exchange data obtained. Calculation of the equilibrium constants.

S. K. NANDI, Calcutta.

The exchange equations of Ganssen, Jenny and Bray have been compared in the light of the exchange measurements at symmetry concentration (i.e., an amount equivalent to the total amount of exchangeable cation present in the clay) of the added, electrolytes. The constant of the equation of Ganssen have been calculated from the data obtained in the exchange reactions. It can be deduced from the equations of Ganssen, Jenny and Bray that K_G (Ganssen's constant) is reciprocal of K_J (Jenny's constant) which is again equal to square of Bray's constant (f^2), only at symmetry constant and not at any other concentrations.

22. A comparative study of the base exchange equations of Wiegner, Renold, Jenny, Bray and Ganssen in the light of the exchange measurements carried out at various concentrations of the added electrolytes.

S. K. NANDI, Calcutta.

In the present investigation the equations of Wienger, Renold, Jenny, Bray and Ganssen have been compared in the light of the exchange data obtained at other concentrations besides the symmetry concentration. The following conclusion can be drawn from the calculation of the various constants. (a) K_W (Wiegner's constant) has a constant value throughout the range of concentrations studied in all the systems except in one case where deviation is observed. (b) K_R (Renold's constant) shows a gradual increase as the concentration of the added electrolyte decreases. (c) K_J (Jenny's constant), K_B (Bray's constant) and K_G (Ganssen's constant) are related to one another at symmetry concentration only. They do not show the same degree of constancy in all the systems as K_W. (d) K_J is not equal to the square of Bray's constant (K_B) as observed by Bray, except at the symmetry concentration.

23. Cation exchange in heteroionic clays.

S. K. NANDI, Calcutta.

A study has been made of cation exchange of heteroionic or mixed clay salts having equal proportion of the two exchangeable cations. They were prepared by adding to the H-bentonite the bases M_1OH and M_2OH each in amount equivalent to half the base exchange capacity of H-bentonite; M_1OH being added first and then M_2OH for the preparation of M_2-M_1-bentonite; the sequence of addition of the bases is reversed to obtain M_1-M_2-bentonite; simultaneous addition of M_1OH and M_2OH has been made for obtaining $\left.\begin{matrix}M_1\\M_2\end{matrix}\right\}$-bentonite

Exchange of the two cations from these mixed bentonites against monovalent and bivalent electrolytes added at symmetry concentration has been studied.

Almost equal amounts of $Na+$ and $K+$ are exchanged from Na-K-bentonite and K-Na-bentonite. The sequence of addition of cations in the preparation of clay salts has therefore little effect on their exchange, unlike that observed by Renold in the case of mixed permutites. However in the case of $\left.\begin{matrix}Na\\K\end{matrix}\right\}$ bentonite, where the cations are added simultaneously the exchange of $K+$ is considerably less than that of $Na+$.

Cations in other binary clays containing either a monovalent and a bivalent or both bivalent bases, in equal proportions show no difference in their exchangeability, whatever be the method of preparation of the clays.

24. Contribution of clay fraction of soils towards their base exchange capacities.

S. K. NANDI, Calcutta.

In the present investigation the contribution of clay fraction towards the base exchange capacity of the soil has been studied. The contribution of clay in some soils has been found to be above 90%, in others it is somewhat less. The base exchange capacities of the soils have been compared with the values calculated from the percentage of clays and the base binding capacities of the hydrogen clays isolated from them. The observed and calculated values in the case of some soils show a better agreement than those of others. The difference between the observed and calculated values of the base exchange capacity of these soils is found mainly due to the presence of an appreciable quantity of the silt fraction.

25. Cation exchange in homoionic clays. I.—Symmetry values and the lyotrope series of cations.

S. K. NANDI, Calcutta.

The exchange behaviour of clays saturated with metal cations, the relative exchange powers of various cations and symmetry values (i.e., percentage of cation exchanged from a clay, when the amount of the added cation is equal to the total amount of the cation present in the clay) have been studied with respect to the lyotrope series. The relative exchange powers of various cations as indicated by symmetry values of a particular clay salt against these cations can be arranged in most cases in the form of lyotrope series. A significant variation is the greater relative effect of Mg^{++} than Ca^{++} observed with one clay salt. NH_4^+ and K^+ often interchange positions. H^+ occupies a variable and anomalous position in the series. The lyotrope series is not generally obeyed, when symmetry values of different clay salts against a particular electrolyte are compared.

26. Cation exchange in homoionic clays. II.—Symmetry values and hysteresis in Cation exchange.

S. K. NANDI, Calcutta.

The exchange equilibrium, approached from either side of a balanced exchange reaction, schematically represented by the equation, $\text{M-clay} + \text{M'A} \rightleftharpoons \text{M'clay} + \text{MA}$, should be represented by the same relative proportion of the cations involved. A study of a number of exchange reactions carried out with clay salts prepared from Kashmir bentonite revealed that in majority of cases a hysteresis effect exists, i.e., the same equilibrium is probably not attained from either side. The symmetry value of the M-clay against M' and that of M'-clay against M, determined separately should add up to 100. The sum of the two symmetry values is less than 100 in the majority of cases. In some cases it is greater than 100. These discrepancies might arise from the exchange of varying amounts of 'residual' H^+ ions in the clay salts for the added cations or to the adsorption characteristics (hysteresis) of the clays themselves.

27. A limiting value of the base exchange capacity of soils and clays.

S. K. NANDI, Calcutta.

It has been established by our previous work that in the methods of measuring the base exchange capacity (b.e.c.) the optimum cation and pH effects must be ensured. For example, if the concentration of the exchanging cation is comparatively high and the pH is adjusted as near the neutral region as possible, the exchange is most favourable; consequently a high b.e.c. is obtained. The present work was carried out to investigate whether by a suitable choice of conditions a still higher value of the b.e.c. could be attained than that given by the routine methods. In pursuance of this enquiry the concentration of the common exchanging cations e.g., Ba^{++} and Mg^{++} used for leaching was increased several times and the amount of cations adsorbed in the process were estimated. The pH was maintained at 7·0 or at 8·5 in some cases. In addition to this a number of cations, some of them polyvalent e.g., La^{+++} and Th^{++++} were used to leach desaturated soils, clays isolated from soils as well as a montmorillonitic clay mineral and from the amounts of cation adsorbed the total exchange capacity was calculated. It was found that the b.e.c. varies more or less in the following order :

$N\text{-}Zn(CH_3COO)_2 > N/10\text{-}Th(NO_3)_4 > 4N\text{-}MgSO_4 > 8{\cdot}5N\text{-}Ba(SCN)_2$
pH 6·3 pH 1·9 pH 8·5 pH 8·5
$> N\text{-}MgSO_4 = N\text{-}Ba(SCN)_2 = N\text{-}La(NO_3)_3 > 4N\text{-}Ba(CH_3COO)_2$
pH 7·0 pH 7·0 pH 5·9 pH 7·0
$> N\text{-}Ba(CH_3COO)_2 = N\text{-}CH_3COONH_4 = N/30\text{-}Ca^{++}$ (half neutralised p-nitrophenol)
pH 7·0 pH 7·0
$= Ba^{++}(Ba(OH)_2\text{-}N\text{-}BaCl_2)$

High values of b.e.c. thus obtained are often ascribed to a greater adsorption of the cations. But a closer scrutiny together with the fact that a smaller NH_4^+ adsorption is observed when the 'base' saturated systems were leached with CH_3COONH_4 solution to get back the adsorbed bases, showed that in many cases the cations were adsorbed as hydroxy cations e g., as $MgOH^+$ or $Th(OH)_3^+$. Consequently calculated on the basis of metal cations the exchange capacity should show a misleadingly high value. One of the processes involving the use of $Ba(SCN)_2$, however, gave a genuinely high value. This is ascribed to a very high cation concentration obtaining in a saturated solution (8·5N) that was used for leaching and maintenance of an almost constant pH near about 8·5. Here again therefore a suitable choice of the same factors which determine the b.e.c. of soils and clays enables us to ascertain more or less the limit of exchange capacity.

28. Base exchange capacities of soils and clays and their mineralogical makeup.

S. K. NANDI, Calcutta.

From the value of base exchange capacity of the clays a fair idea of the nature of the mineral could be obtained particularly in correlation with X-ray data of some of the clay colloids. The black cotton soils are shown by X-ray analysis to contain montmorillonite as the dominant mineral constituent. This is confirmed by the high base exchange capacity of the soils as well as of their clay fractions. The alluvial, lateritic, red and desert soils have lower base exchange capacities. The clay fractions isolated from Latekujan and Suri soils are kaolinitic as revealed by X-ray, but the base exchange capacities of the clays are too high for kaolinite alone. The presence of some amount of montmorillonite in Latekujan soil is responsible for its high base exchange capacity. Suri soil, most likely contains montmorillonite or illite in such amounts which are not detectable by X-ray. The high potassium contents in clays isolated from Rajshahi, Latekujan and Oating soils, suggest the presence of illite. The high b.e.c. values of clays from Rajshahi, Kalyanpur and Burdwan soils show that they are obviously mixtures of clay minerals.

29. Studies on ionic competition in base exchange reactions of homo-ionic montmorillonites.

S. P. MITRA, Allahabad.

The relative influence of cations in mixtures on the exchange of other cations from homo-ionic montmorillonites where there is a competition between two cations in the replacement of a third cation has been studied. The general finding is that divalent cation in a mixture of mono and divalent cation or the more strongly adsorbable cation in a mixture of either the mono or divalent cations has the tendency to suppress the entry of the companion ion.

30. Comparative study of different methods of determining cations from clays and micas.

S. P. MITRA, Allahabad.

As a result of comparative study of various methods of determination of exchangeable cations, it has been observed that Schollenberger's method is quite well suited for cation exchange determination as the ammonium adsorbed gives an accurate measure of the cation exchange capacity at pH 7.

31. Phosphate adsorption by cation exchange systems.

S. P. MITRA, Allahabad.

Phosphate adsorption by calcium, magnesium, hydrogen, ammonium, barium, potassium and sodium montmorillonites shows that Ca-montmorillonite absorbs the greatest amount of phosphate and Na-Montmorillonite absorbs the least.

32. Influence of anions and cations and the nature of the exchange material on the exchangeability of cations.

S. P. MITRA, Allahabad.

Exchanges of calcium, magnesium, potassium and sodium from natural cation exchangers were found to be influenced by the nature of anions and cations in the replacing solution and also by the kind of exchange material.

33. Adsorption of potassium by kaolinite, montmorillonite, halloysite and natrolite as influenced by concentration and pH of the solution.

S. P. MITRA, Allahabad.

The adsorption of potassium by clay minerals under varying conditions of concentration and pH have been studied. It is obvious from the experimental data that montmorillonite shows greatest adsorption at all pH values. The adsorption was found to vary with the concentration of potassium in solution, pH and the nature of cations in the exchange complex.

34. Some reactions of monocalcium phosphate with minerals.

S. P. MITRA, Allahabad.

The adsorption of monocalcium phosphate with vermiculite, biotite, montmorillonite and halloysite showed that both Ca++ and $H_2PO'_4$ are adsorbed. In acidic medium, the adsorption was considerable and obeyed the Freundlich's adsorption isotherm. pH of the equilibrium solution was always higher than that of the original solution. This could be ascribed either to the liberation of OH' ions from the crystal lattice of the minerals or to the removal of H+ ions from the solution.

35. Study of some Andhra Pradesh Clays by Differential Thermal Analysis, Part II—Thermal Studies of Different Clay Fractions.

A. V. RAJESWAR RAO and ABDE ALI, Hyderabad : Dn.

Four washed clays of Andhra Pradesh further fractionated to 2μ and below size groups by sedimentation, as well as three fractions (76–34μ, 34–10μ and below 10μ) obtained for two of the clays (Srirangapur and Chintriyal) by elutriation were subjected to d.t.a.

The Shekapur clay revealed the concentration mainly of kaolinite in 2μ and below size fraction and a total absence of non-clay mineral dolomite, which was originally present in the unfractionated but washed clay. The thermal reactions were more pronounced with finer fractions.

The finer fraction of Pachegaon clay showed improvement in the content of kaolinite and presence of only small amount of free quartz as against large amount present in the washed clay (over 20 per cent).

Little difference was noticed between various fractions of Srirangapur clay except that the finer ones showed characteristic peaks of slightly greater magnitude for montmorillonite and kaolinite, the former being present in larger amount.

The Chinitriyal clay, which recorded the absence of any clay mineral patterns, exhibited marked differences in thermal reactions in all the elutriated and sedimented fractions. The thermal reactions decreased with increased fineness of the particle sizes. The 34–10μ fraction showed the maximum amount of free quartz (more than 30 per cent), whereas the fraction 2μ and below indicated the presence of only a small amount.

36. Ion Exchange Studies on the Composition of Some Indian Ceramic Clays.

(Miss) KAMALA ZUTSHI and ABANI K. BHATTACHARYA, Jaipur and Agra.

Chemical analysis of Kasimbazar, Chitrakoot, and Katni clays (obtained from Govt. Pottery Works, Khurja, U.P.) has been performed to determine the individual exchangeable bases, viz., Ca, Mg, Na, and K, and the total cation exchange capacity. The results have shown that the exchangeable Ca is the highest in the Kasimbazar clay following the order Kasimbazar>Chitrakoot>Katni, while the exchangeable Na is the lowest. The variations of exchangeable Ca and Na are just the reverse in the case of Katni clay. The total cation exchange capacity also follows the same order as that of exchangeable Ca. The observations reflect that these differences arise from the residual charges on the lattices of the clay minerals of which these ceramic clays may be composed. Katni clay may be put in the kaolinite group but Kasimbazar and Chitrakoot clays do not exactly conform to this grouping. This may be visualised that these two are composed of similar silica-alumina units and that Ca, Mg, Na, and K may have entered either as pure silicates or by replacement in the lattice or the clay minerals.

Since the exchangeable fraction of Na and Mg is comparatively much less in majority of these clays except in Kasimbazar, it may be concluded that Mg and Na may have entered the mineral lattice with greater ease than Ca and K. The entry of these ions of lower valency within the lattice structure may become possible by the substitution of trivalent Al giving a residual charge. The hydrogen of the exposed hydroxyls in the silica units may also be responsible for holding some fraction of the bases in an exchangeable form. Fe can easily substitute Al by isomorphous replacement without affecting the net charge of the clay complex. All the above mentioned possibilities can be visualised to explain the variations observed in the exchangeable bases of these clays.

37. Base Exchange Studies on Natural Rajmahal and Synthetic Clays.

(Miss) KAMALA ZUTSHI and ABANI K. BHATTACHARYA, Jaipur and Agra.

Percentage composition of Rajmahal ceramic clay was determined. Different samples of synthetic Rajmahal clay with various composition were prepared by mixing the collodial solutions of iron and aluminium hydroxides and silicic acid together with soluble salts of calcium, magnesium, sodium, and potassium. These substances, however, formed the constituents of the natural clay. Five samples were prepared. The first corresponding exactly with the percentage composition of the natural clay. The other four by mixing the constituents in various proportions. One of these was allowed to age for six months. Base exchange properties and the pH of the natural as well as the synthetic samples were determined. The results showed that in the preparation of the synthetic clays, variable quantities of free silica, aluminium, calcium, magnesium, sodium, and potassium do not strictly obey stoichiometric proportions. In all cases iron hydroxide sol was completely used up for all proportions of mixing. It is noticed that there is no correspondence in the individual exchangeable bases, the total cation exchange capacity, and the degree of base saturation of the natural and synthetic clays. The pH value of the natural clay corresponds agreeably with the degree of base saturation calculated from the data of the individual exchangeable bases, but those of synthetic clays do not show such correspondence. The SiO_2/R_2O_3 ratio also did not show any order in both the natural and synthetic clays, though they have some superficial resemblance, are not actually identical with the natural clays as also suggested by Weiser, H.B. (The Colloidal Salts, *3*, 411, 1938).

38. Water Stabilities of Aggregates in Heated Coils.

K. SUBBA RAO, New Delhi.

The increase in permeability for water of a heated soil has been attributed to the aggregation of soil particles by heat. In the present paper the stabilities of the soil aggregates in the normal and heated soils are reported.

Dry and wet sieve analyses have been carried out with the Gangetic alluvial soil of Delhi heated to temperatures of 60°C, 150°C, 225°C, 360°C, 600°C, 800°C and 1000°C. The dry sieve analysis curves of normal and heated soils are almost coincident and this indicates that heating has not produced any appreciable change in the particle size distribution in the soils. The wet sieve analysis curves of normal and heated soils are separated. The curve of normal soil has shown the maximum shift. The shift indicates that the aggregates in normal soil are unstable and they disintegrate on shaking with water.

Therefore the effect of heat on a soil is mainly to stabilise the aggregates which are already present in the normal soil rather than to promote fresh aggregation. This stabilization of soil aggregates steadily increases with increase in the temperature of heating upto 360°C at which the aggregates become quite water stable. Above this temperature, the stability semains unchanged.

39. Permeability in Relation to Water Stability of Soil Aggregates.

K. SUBBA RAO, New Delhi.

The stability of the aggregate in a soil determines the stability of the porous structure of the soil and this in turn determines a permeability of the soil for water. In this paper studies have been made on the relative water stabilities of the soil aggregates in certain Indian soils and also their influence on the permeability for water.

Dry and wet sieve analyses and permeability measurements were carried out with the following soils—red, laterite, black, alluvial, forest, desert, saline, alkaline and peaty. Soil aggregates in the different soils disintegrate to different extents in water. The instabilities of the aggregates of different soils are indicated by the instability factors. The permeabilities of different soils bear a satisfactory relation to particle size distribution in the wet state rather than in the dry state.

The dry and wet sieve analyses and pF-water relations have been studied with the alluvial soil in the normal and aggregated states. The pF-water relation has also been studied with the black soil soaked in water over different intervals. When an aggregated soil is gently soaked in water as in the porous plate tensiometer apparatus, it does not undergo disintegration to the same extent as in the wet sieve analysis apparatus. On prolonged soaking in water the soil aggregates suffer increased disintegration as indicated by the difference in pF-water curves of black

40. Effects of particle size and exchangeable cations

GURUDAS MANDAL and D. LAHIRI, Calcutta.

The effects of particle size distribution, nature of exchangeable cations and minerals present in clays on plasticity determined by Atterberg's method have been studied. It was found that ultimate size of the particles and particle size distribution had influence on the two limits of plasticity and the plasticity number. Rajmahal clay gave low value of lower limit of plasticity and considerably high plasticity number, while some other coarser clays and a fine English ball clay, gave higher values of the lower limit of plasticity indicating that only the ultimate size of the particles does not govern the lower limit of plasticity. When mixtures of finer and coarser clays, were tested, it was found that while plasticity number was almost additive, the values of lower limits were much lower. This showed again the importance of distribution of particles on the plasticity of clay.

Of the Kaolinitic types of clays NaOH reduced plasticity number of Rajmahal clay greatly, and of others to a lesser extent, while in case of clays of other types, NaOH increased the same to a considerable extent. The effect of Ca++ was intermediate between those of Na+ and H+. The great reduction of plasticity of Rajmahal clay by alkali in comparison to other coarser or finer clays lent further support of the influence of particle size distribution on clay plasticity.

41. Na+/K+ Exchange Equilibrium in Clays.

SAROJ KUMAR BOSE,* Calcutta.

The activity of individual ions in a binary mixture has been evaluated in order to study the forward as well as the reverse reactions with the clay system :

$$\text{Na-clay} + \text{KCl} \rightleftharpoons \text{K-clay} + \text{NaCl}$$

Calculated amounts of either KCl or NaCl are added to the respective clays and the activity of the individual ions in the mixture is evaluated. For this purpose a resin membrane and a clay membrane electrode having respectively 1·62 and 5·87 as the mobility ratios are used. The trend of the graphs for a_{NA} and a_{K} against the concentration of the added electrolytes in the forward reaction is more or less the same as the a_{K} and a_{NA} graphs respectively for the reverse reaction. But the actual values of a_{NA} and a_{K} of the forward and the reverse reactions do not correspond with each other. This suggests that a 'Hysterisis' effect is present even if two similar valency ions are concerned.

42. The role of salting out effect in countercurrent distribution.

P. P. MUKHERJEE, S. B. GHOSH and P. N. NANDY, Calcutta.

So far as our knowledge goes the interesting role of salting out effect has not been previously studied by any worker in this line.

The two immiscible phases constituting the solvent system in which a solute to be distributed in the countercurrent distribution apparatus are made mutually saturated prior to the experiment, so that during actual operation only the distributing solute may be partitioned, rendering the solvent composition unaltered.

In actual practices, however, it is seen that the solute, in addition to being partitioned, affects the mutual solubility of the two solvent phases by a sort of salting out effect. When this results in an appreciable change of composition of the solvent system accompanied with a change of volume ratio of the two phases, interesting results may follow, as has actually been found in our laboratory.

This effect generally depends on the nature and composition of the solvent system and the nature of the solute and its concentration and is seen most prominent in presence of a solute which is soluble in only one of the two phases.

This interesting phenomenon has been studied in a series of countercurrent distribution of the dyes methylene blue (E. Merck) and neutral red (E. Merck) of various initial concentrations in a system of 1% Hcl soln. and butanol (E. Merck).

Change of relative volume of the solvent phases due to salting out effect suggests a possibility of a component, having a negligible partition ratio or having no partition in the upper phase at all, of proceeding with the lower phase accompanied with the upper phase during each transfer and giving a distribution band and thus somewhat defeating its separation from a component which is distributed by partition phenomenon. Distribution of an impurity associated with neutral red and cause of failure of separation of the colourless components from the coloured one in a mixture of antibiotics obtained from the strain B_7 when distributed in a ternary solvent system, methanol (9 vols.) : petrol ether (22 vols.) : Benzene (12 vols.) were explained by salting out effect.

From the study of countercurrent distribution of neutral red in a solution of methylene blue of various concentrations in 1% Hcl solution and butanol it is shown the possibility of distribution of the carrier or salting in agent itself during countercurrent distribution though the system previously mutually saturated and thus the accuracy of the gravimetric estimation may be affected.

43. Preliminary studies on the changes of pH. value conductivity and base-exchange properties of Aligarh soils during hydration and artificial humification by organic matter.

NASEER AHMAD and M. FAZLUR RAHMAN, Aligarh.

Experiments on the variations of pH and conductivity of three different samples of aligarh soil were carried out during their humification under natural conditions. The soils were moistened 1. by spraying water twice a day and 2. by adding sufficient amount of water and allowing excess to drain out. It was observed that the three samples watered under these conditions show a regular increase in pH and no periodicity with time during humification and hydration could be observed within a period of 30 days. Conductivity regularly decreases in three samples, an increase for 20 days however could be observed in soil no. 1 containing no humus. These results throw some light on the decrease of water soluble salts in our samples.

Soil No. 3 shows a behaviour different from the other two in the amount of exchangeable Ca during humification. A regular decrease in exchange Ca was observed in soils no. 2 and 1 and hydrated sample no. 1. A useful relationship between exchangeable Ca and humification can only be established if factors like the nature of the clay, composition of humus, the kind of water and physical properties like porosity permeability, etc., are taken into consideration.

44. Magnetic and Spectrophotometric Studies on Glasses Containing Manganese.

ATMA RAM, S. KUMAR and PRABHU NATH, Calcutta.

Borate, phosphate, boro-phosphate, fluophosphate and silicate glasses containing various alkali and alkaline earth ions, Pb^{2+} etc., were studied. Magnetic measurements showed that

(1) in glasses melted under reducing condition only Mn^{2+} was present.
(2) in addition to this, substantial amounts of Mn^{3+} was also present in glasses melted under oxidising conditions and their amounts were found out.
(3) High melting temperature and acidity of the base glass favoured reduction to Mn^{2+} and vice versa.

Spectrophotometric measurements showed the presence of a strong absorption band in oxidised glasses, ascribed to Mn^{3+} ion. 5_g state of Mn^{3+} was split up into two energy levels by the electric field of the ions surrounding Mn^{3+} in glass. The absorption band was due to transition from lower to higher energy state by absorption of light energy. The band shifted when splitting of the two levels changed, i.e., when the electric field due to surrounding ions was changed.

Mn^{2+} ion was in 6_g state which cannot be split by the internal electric field. Weak optical absorption band observed in reduced glass may be due to some other type of weak splitting of the ground term of Mn^{2+}.

Knowing the amount of Mn^{3+} from the values of magnetic susceptibility and specific extinction coefficient for Mn(EMn) from spectrophotometric measurements, EMn^{3+} for $-Mn^{3+}$ ion was calculated and was also found to vary with changing base glass composition. EMn^{3+} was about 100 times larger than EMn^{2+} for a particular base glass, as predicted by theory.

Mn^{3+} ion has been used as a tracer to find out the strength of the surrounding electric field due to base glass ions and thus certain informations were obtained concerning structure of glass.

PHYSICAL CHEMISTRY SECTION

45. D.T.A. Technique as Applied to the Study of Solid Catalysts.

V. S. RAMACHANDRAN, P.S. SHANKAR, Roorkee and
S. K. BHATTACHARYYA, Kharagpur.

The technique of differential thermal analysis (referred to as D.T.A., for brevity) has been extensively applied to the study of clays for more than two decades. It is surprising that a systematic investigation of the thermal characteristics of catalysts has not so far been carried out by adopting the D.T.A. technique.

Thermal characteristics of a number of single oxide catalysts like Cr_2O_3, Fe_2O_3, TiO_2 ZnO and Al_2O_3 and binary systems like Fe_2O_3— Cr_2O_3, ZnO— Cr_2O_3 and NiI_2—SiO_2 have been studied and the results of D.T.A. have been compared with those of X-ray diffraction and surface area measurement. A good correlation has been observed in many cases.

46. Separation of the Homogeneous and Heterogeneous Parts of the Thermal Decomposition of Gaseous Zinc Dimethyl.

LOURDU M. YEDDANAPALLI and R. GANESAN, Madras.

The thermal decomposition of zinc dimethyl vapour has been studied over the temperature range 320 to 385°C at an initial alkyl pressure of 200 mm. Hg. at 29°C. Methane, ethane and ethylene constitute about 97% of the total gaseous products of which methane is the most abundant, the rest being hydrogen and acetylene.

A critical examination of the results at different temperatures and those reported earlier for packed and unpacked reaction vessels, shows the over-all decomposition of zinc dimethyl to consist of a homogeneous and a heterogeneous reaction occurring simultaneously. On the basis of a mechanism for each of these processes, attempt is made to account satisfactorily for the products of the total decomposition and to evaluate the exact ratio of the two processes at different temperatures. The suggested mechanism for the heterogeneous process is in keeping with the observed value of 1·5 for the heterogeneously produced methane to metal alkyl thus reacted. The homogeneous mechanism leads to a rate equation from which it is possible to deduce for the hydrogen abstraction reaction, $CH_3 + Zn(CH_3)_2$ giving methane, an activation energy of 9·6 kcal. per mole, which is of the right order of magnitude for similar hydrogen abstraction reactions.

47. Differential Thermal Analysis of the Systems, NiO and Fe_2O_3-Al_2O_3.

G. SRINIVASAN and S. K. BHATTACHARYYA, Kharagpur.

The differential thermal analysis (DTA) technique is applied to study the thermal behaviours of nickel oxide, precipitated from different nickel salts and iron oxide-alumina gels of varying compositions, coprecipitated from nitrate solutions. Correlation of the data with the catalytic activity of these systems is attempted.

Nickel oxide, irrespective of the method of preparation shows a small endothermic depression at about 105°C due to the loss of adsorbed water and a huge endothermic peak at about 335°C (range 250°–380°C) due to the dehydration reaction,

$$NiO.H_2O \text{ crys.} \longrightarrow NiO \text{ crys.} + H_2O.$$

Thus, the complete expulsion of water takes place at about 360-400°C and this corresponds to the range at which nickel oxide is utilized as a hydrogenation catalyst.

Pure alumina gives two endothermic peaks, one at 140°C due to the loss of adsorbed water and the other at 330°C due to the formation of γ-alumina. In the case of pure ferric oxide gel, an endothermal elimination of adsorbed water and an exothermic transformation from the amorphous to the crystalline state are observed at 150° and 409°C respectively. All the coprecipitated ferric oxide-alumina gel mixtures expel the physically adsorbed water in the temperature range 100°-250°C. The exothermic peak due to the crystallisation of ferric oxide is shifted to higher temperatures in the mixed gels containing alumina upto 40%. It is clear from the DTA results that addition of alumina to ferric oxide to the extent of 40 mole per cent protects the latter from crystallisaion. These composition ranges may correspond to enhanced surface properties and catalytic activity.

48. Solid State Reactions in the System Fe_2O_3-TiO_2.

M. D. KARKHANAVALA and A. C. MOMIN, Bombay.

A study has been made of the binary system Fe_2O_3-TiO_2, by solid state reactions under dry and hydrothermal conditions. Under dry conditions only one binary compound-Pseudobrokite (Fe_2O_3-TiO_2) is formed and no evidence of solid solution on either side of this compound at 1000°C was obtained. The system appears, under these conditions, to be a simple binary with a single binary compound.

Under hydrothermal conditions of 300°C and 1500 p.s.i. equilibrium does not seem to have been reached even after 240 hours. The general pattern indicates the existence, under these conditions, of hematite and anatose in varying proportions together with a third phase over a limited range of composition. The exact nature of this phase is not as yet known but it gives an X-ray pattern similar to that of natural Arizonite ($Fe_2O_3.3TiO_2$).

49. Kinetics of Oxidation of Arsenite by the Persulphate.

YUGUL KISHORE GUPTA and SATYESHWAR GHOSH, Allahabad.

Persulphate-arsenite reaction has been studied for the first time. The kinitics were followed by estimating the unoxidized arsenite left over at different intervals of time, by titrating against standard permanganate. The reaction was found to be zeromolecular with respect to the arsenite and unimolecular with respect to the persulphate. Copper and silver have great catalytic influence on this reaction as in other persulphate oxidations. The results are reproducible with the same arsenite and persulphate solutions. Different arsenite solutions make marked deviations due to, perhaps, traces of impurities even in the redistilled water. In some of the reactions, the velocity appeared to be very irregular, which may be due to the peculiarity in the reaction itself.

50. Kinetics of Oxidation of Ethylene Glycol by Chromic Acid.

A. C. CHATTERJI and SAMIR KUMAR MUKHERJEE, Lucknow.

The order of the reaction with respect to ethylene glycol, H+ ion and chromic acid has been determined. The temperature coefficients for various temperature ranges between 25° and 55°C have also been determined at different concentrations. The frequency factor have been calculated from the equation, $K=Ae^{-E\ RT}$. From a knowledge of the above results a mechanism for the oxidation of ethylene glycol has been suggested.

51. Kinetics of Oxidation of Prophylene Glycol, 2 : 3 Butylene Glycol and Pinacol by Chromic Acid.

A. C. CHATTERJI and SAMIR KUMAR MUKHERJEE, Lucknow.

A Kinetic study for the oxidation of Propylene glycol, 2 :3 Butylene glycol and Pinacol with Chromic acid has been made. The orders of the reactions with respect to glycols, chromic acid and H+ ions have been determined. Products of the reactions were isolated and estimated. Effect of some metallic salts on the oxidation rates have been studied. A possible mechanism has been proposed for the oxidation of ethylene and methylated ethylene glycols in general from these infomations.

52. Kinetics of Oxidation of Formaldehyde by Chromic Acid.

A. C. CHATTERJI and SAMIR KUMAR MUKHERJEE, Lucknow.

A kinetic study for the oxidation of Formaldehyde by chromic acid has been made. Order of the reaction with respect to chromic acid, formaldehyde and H+ ion has been found to be one, one and two at all the H+ ion concentrations. The temperature coefficients for the various temperature ranges between 25° and 55°C at various concentrations have been determined. Effect of some salts on the oxidation rates have been studied. The induction factor for the induced oxidation of manganese sulphate to manganese dioxide has been found to be 0·5. From a knowledge of above results a possible mechanism for the oxdiation of formaldehyde by chromic acid has been proposed.

53. Decomposition of Hydrogen Peroxide.

B. P. GYANI and D. R. NABE, Patna.

A number of views have been proposed regarding the mechanism of decomposition of H_2O_2 in solutions in presence of ferric and other ions. The essential feature of these views is that the catalyst ions must have two oxidation states and free radicles (HO, HO_2) should be produced as intermediates. These views appear to be supported from our experiments with ferric, ceric, cupric and manganous ions. The rates fall in the order given. However, when we consider the corresponding insoluble oxides, the order is $MnO_2 > CuO > Fe_2O_3 > MnO$. It appears therefore that not only the ionization potentials (and hence the entropies of ions in solution) may be important in determining some stages of catalysis but also steric factors. The H_2O_2 molecule may be attached to the catalyst ion or the solid surface at more than one point and smaller or larger strains may be produced in it depending upon the distances between points of attachment and nature of attachment.

54. Methoxy-Mercuration of Methyl Acrylate.

KANAI LAL MALLIK and MIHIR NATH DAS, Jadavpur, Calcutta.

Kinetic studies have been carried out on methoxy-mercuration of methyl acrylate at 35°, 40° and 45°C, using mercuric acetate and methyl acrylate at concentrations $2{\cdot}5\text{-}5{\cdot}0 \times 10M^{-2}$ in methanol solutions. The reaction was followed by analysis of the mercury acetate at regular intervals by non-aqueous titration with standard hydrochloric acid using thymol blue as indicator.

The kinetic results definitely indicate a bimolecular reaction, with the specific reaction rates at 35°, 40° and 45°C being respectively 0·067, 0·096 and 0·14 litre $mole^{-1}$ sec^{-1}. The energy of activation calculated from these results comes out to be of the order of 36 Kcals/mole.

Addition of acetic acid is without any appreciable effect on reaction rate, which is contrary to the observation made by other workers for methoxy-mercuration of cyclohexene. Lauroyl peroxide is also found to be without any effect, though peroxides are reported to act as catalysts in methoxy-mercuration reactions in general. An apparent state of equilibrium is found to be attained after about 90 per cent reaction, but starting with the mercurated product, the reverse reaction is not found to occur.

Preliminary work conducted on methoxy-mercuration of ethyl and butyl acrylates indicates essentially similar features.

55. Kinetic Study of the Oxidation of Toluene by Manganic Sulphate.

M. S. VENKATACHALAPATHI, R. RAMASWAMY and H. V. K. UDUPA,
Karaikudi.

A kinetic investigation of the oxidation of toluene by manganic sulphate is described. Under the conditions employed, the methyl group in the ring is attached chiefly, yielding a stepwise oxidation of toluene to benzaldehyde. Disruption of the aromatic nucleus does not take place and no benzyl alcohol was detected in the products of the oxidation. Resinous substances and self-condensation products of certain intermediates were formed. The reaction is of the first order with respect to the concentration of manganic sulphate. The manganic sulphate employed in these investigations was prepared electrolytically using lead electrodes and manganous sulphate in fifty-five per cent sulphuric acid as electrolyte.

56. A reaction between Iodine and Sodium Hydroxide in Heterogeneous Liquid-liquid System. Part IV.

P. S. JAVADEKAR, Sangli.

A reaction between Iodine solution in Chlorobenzene and aqueous Sodium hydroxide is studied in the present investigation. The temperature coefficients are 1·106 (between 34°C and 24°C) and 1·17 (between 44°C and 34°C). This indicates the predominance of diffusion process. However the effect of change in speed of stirring from 200 to 270 revolutions per minute is not appreciable. The effect of change in concentration of Iodine from 0·01N to 0·02N and 0·03N solution is very remarkable. The velocity constants decrease with increase in concentration of Iodine. A solution of alkali affects the interfacial tension and hence this effect was expected. The effect of change in concentration of alkali is under investigation. The addition of surface active reagents will also throw more light on the concentration of the reactants at the interface.

57. "Catalytic Decomposition of Potassium Chlorate in the Presence of Sulphate of Iron (Ferrous), Nickel and Cobalt, and the Determination of Temperature Co-efficient of the Decomposition."

L. M. APTE and P. S. JAVADEKAR, Sangli.

Sulphates of Iron, Nickel and Cobalt as catalysts are used to decompose potassium chlorate. It is found that catalytic influence of Cobalt is greater than Iron and Nickel as catalysts. But higher proportion of catalyst does not materially alter the decomposition constants.

The temperature coefficients of the decomposition are determined between the temperatures 255°C, 265°C and 275°C.

58. The influence of some Protective Colloids on the Corrosion of Brass.

A. M. TRIVEDI and M. N. DESAI, Ahmedabad-9.

During studies in Corrosion of brass by souring substances like Tamarind, Kokum, Holplums, Lemons it was found that the corrosion is lower with these substances as compared to corrosion by solutions of the same pH prepared from corresponding acids. The retardation may be attributed to the naturally occurring colloids in the above substances. An attempt is made to study the effect of different concentration of Gelatin, Pulvis acacia, Starch, Egg Albumin, Agar and Dextrin on the corrosion of brass in citric acid.

It is found that the colloids retard the corrosion of brass, by citric acid. In many cases the adsorption law is obeyed. Pulvis acacia and Egg-Albumin appear to be efficient even at low concentrations. The inhibitive power is in the order Pulvis acacia>Egg Albumin>Gelatin >Agar>Dextrin >Potato starch.

59. Studies on the Kinetics of the Salt Effects on the Mutarotation of Xylose in Aqueous Solutions.

S. L. GUPTA, Pilani.

The effect of strong acids like HCl, HBr and HNO_3 and mixtures of these acids and neutral salts like KCl, KBr, KI and KNO_3 on the rate of mutarotation of xylose in aqueons solution has been investigated and found to be very interesting. It is found in general that with increase in concentration *C* of the acid, the velocity constant *K* increased progressively obeying a relationship, $K/\text{min.}^{-1} = 0\ 076 + 2{\cdot}02\ C$. Where *C* represents the molar concentration of the acid. Furthermore, it is shown that the points referring to all the three acids fall roughly within experimental error on the same line (*K* Vs. *C*) indicating that the above equation governs the effect on the velocity constant of all the three acids. This indicates that the anions of strong acids have no significant effect on the rate of mutarotation of xylose.

This fact is further substantiated by the study of the effect of the mixtures of these acids and neutral salts on the rate of mutarotation of xylose which show that the velocity constant is almost the same for different salts. This observation is of marked importance and gives information about the nature, especially the electrically charged character of the resulting complex undergoing change and leads to the conclusion that the complex involved in the case of mutarotation of xylose is electrically uncharged in character

60. Studies on the Kinetics of the Mutarotation of Xylose.

S. L. GUPTA, Pilani.

This piece of work relates to the studies on the kinetics of the mutarotation of xylose in aqueous solution.

The mutarotation of xylose has been found to obey first order law with a velocity constant of 0·076 min.^{-1} at 25°C for 4% solution of xylose in conductivity water. The effect of concentration of xylose on the rate of mutarotation has also been studied and it has been found that the velocity constant is almost independent of the concentration of xylose up to the concentration of about 15% whereas greater concentrations show very slight decrease in the velocity constant.

The effect of temperature on the rate of mutarotation as catalysed by water as well as by 0·02 M-HCl solution has been studied. It is found in general that the rate of mutarotation is enhanced by the increase in temperature and that the acceleration of the hydrogen ion catalysis of the mutarotation with rising temperature is the same as the acceleration by increased temperature of the rate of mutarotation in pure water. The value of the temperature co-efficient comes out to be 2·30 for an increase of 10° in temperature. An equation based on the empirical formula of Van't Hoff, viz.,

$$\log K = C - A/T$$

where C and A are constants has been derived which relates the value of the velocity constant with temperature.

61. Free-Energy of Formation, ΔF°_f of $Fe_2Cl_6(g)$ and $FeCl_3(g)$.

G. V. JERE and C. C. PATEL, Bangalore.

The present literature falls short of the free-energy of formation (ΔF°_f) values of $Fe_2Cl_6(g)$ and of $FeCl_3(g)$. These have been calculated by two methods making use of the ΔF°_f of $FeCl_3$ (solid) and $FeCl_3$ (solid) and the respective vaporization data. These methods are used to calculate the free-energy of vaporization, which when combined with the free-energy of formation of the condensed compound gives the free-energy of formation of the gaseous compound. The average values obtained for $\triangle F^\circ f$ of Fe_2Cl_6 (g) and $FeCl_3$ (g) are respectively $-144{\cdot}5$ and $-36{\cdot}6$ K. Cal/mole.

62. Some Thermodynamical Considerations in The Chlorination of Ilmenite.

G. V. JERE and C. C. PATEL, Bangalore.

Heats of reactions ($\triangle H$), free energies of the reactions ($\triangle F$) and equilibrium constants (K) have been calculated for the chlorination of various constituents of ilmenite (FeO, Fe_2O_3 and TiO_2) at temperatures between 300° and 1500°C. When chlorine is employed for the chlorination of ilmenite in the presence of carbon, the free energy values indicate the spontaneity of the reactions, and the heats of reactions between 400° and 900°C show that no external heating will be required when once the reactions have commenced. The equilibrium data indicate the possibility of the preferential chlorination of iron constituents at and below 800°C, and that of titania above 1000°C if all the iron is present as ferrous oxide in the latter case. Calculations of the thermodynamical quantities have also been made for the chlorination of ilmenite by S_2Cl_2, $COCl_2$ and CCl_4 in the temperature range of 300 to 600°C. All these reagents show the possibility of the upgradation of the titania content by preferential chlorination of iron oxides. The heats of reactions show that the chlorination by chlorine will be more economical in the presence of carbon.

63. The Rate of Hydrolysis of Chloroacetamide in Acqueous Acid.

SUNDARESA SOUNDARARAJAN and MARJORIE J. VOLD, Bangalore.

In 0·3N acid the hydrolysis of chloroacetamide follows a bimolecular law with an activation energy and activation entropy both greater than the corresponding quantities for acetamide in accord with predictions based on the charge distribution. However, at even slightly lower acidity the free energy of activation is a continuous function of the hydrogen ion concentration becoming more positive with decreasing acidity in the range studied.

64. Kinetics of Bromination of Anisole by IBr in Carbon Tetrachloride.

LOURDU M. YEDDANAPALLI and N. VENKATESWARA RAO, Madras.

A kinetic study of the reaction between anisole and IBr in carbon tetrachloride has been made with a view to obtain an insight into the reaction mechanism, especially, the nature of IBr catalysis in aromatic brominations. The overall kinetic order is found to be four in the concentration range 0·04M to 0·01M, three with respect to IBr and one for anisole. The temperature coefficient of the reaction is negative throughout the range $-15{\cdot}5$ to $+40$°C, the apparent energy of activation being $-8 \pm 0{\cdot}1$ kcal. mole^{-1}. On adding varying amounts of iodine, keeping bromine and anisole concentrations constant, the rate of bromine consumption reaches a maximum when the ratio of initially added iodine to bromine is 0·49. The above experimental facts are accounted for by a reaction mechanism in which the rate determining step is the removal of bromide ion from 1 : 1 anisole—bromine molecular complex under the catalytic influence of two IBr molecules.

65. Kinetics and Mechanism of Bromination of Anisole by Bromine in Glacial and Aqueous Acetic Acid.

LOURDU M. YEDDANAPALLI and N. S. GNANAPRAGASAM, Madras.

The over-all order of the reaction between anisole and bromine in glacial acetic acid at 30°C gradually decreases from 3·0 to 2·3 as the initial concentration of the reactants is reduced from 0·1 to 0·001M. The increase of temperature from 30° to 50°C brings about a reduction in the over-all order at 0·01M from 2·6 to 2·3. The order with respect to anisole is always one, but that of bromine decreases from 1·6 to 1·3 as the concentration of bromine changes from 0·04 to 0·001M. The activation energy of the reaction in the range 20-40°C is 4·04±0·1 kcal. mole^{-1} at 0·04M and 9·92±0·1 kcal. mole^{-1} at 0·001M. The rate of bromination of anisole is 153 times less than that of phenol.

Increasing the polarity of the acetic acid medium by the addition of different amounts of water enhances the reaction-rate and lowers the over-all order. In aqueous acetic acid containing 25% water, by volume, bromination is 1200 times faster than in glacial acetic acid.

All these experimental facts can satisfactorily be explained by a reaction mechanism in which the polarisation of bromine by solvation is the critical factor determining the rate of bromination.

66. Polarographic Study of the Reaction of Metallic Ions with Globin :—Part I—Cobalt and Nickel.

G. H. AHUJA and C. S. NARWANI, Bombay.

Polarographic curves have been plotted in case of solutions of Cobalt acetate and Nickel acetate respectively of concentration 0·01, 0·015 and 0·02 M in presence of 0·IN KCL as supporting electrolyte and (1) 0·01% globin, (2) 1·0% globin as suppressors at 37°C. The pH in each case was 6·6. There being a great difference in limiting current with 0·01% and 1·0% globin in each case, it is concluded that there is a chemical reaction between globin and the metallic ions Co++ and Ni++. The limiting current increases with concentration of the metallic ions in the solution and the ration of il/ilo is constant. The rate of reaction has also been measured in case of each concentration of the metallic ions in presence of 1·0% globin; the plots of X and log (a-X) against time pertain to reaction of 1st order, because the concentration of globin (Mol. Wt.=68000) in gm. molecules per litre is much less than that of the metallic ion.

The amounts of Co++ and Ni++ combined with globin are nearly same; in each case 20 atoms of metal get combined to one mole of globin. The combination of the metallic ions is expected at the imidazole group of Histidine residue, which can ionize at pH between 6·0 and 8·0. Since one atom of Co or Ni can combine with two imidazole groups, it is concluded that there are 40 moles of Histidine in one gram molecule of globin.

67. Polarographic Studies on Hexametaphosphate—Lead Complexes.

C. S. RAMANATHAN and R. S. SUBRAHMANYA, Bangalore.

Investigations on the polarographic behaviour of complexes formed by sodium hexametaphosphate with the common metal ions have been undertaken with a view to studying the nature of the complexes formed. The metaphosphates are of interest because of their good sequestering properties. The present paper deals with the complexes formed by lead. The effct of adding sodium hydroxide and carbonate have also been studied.

A progressive shift in half-wave potential of lead has been noticed with an increase in the concentration of the complexing agent. The number of ligands attached to the metal ion has been calculated and is found to be one. The results indicate that the carbonate or hydroxyl group does not enter the complex.

68. The Polarographic Behaviour of Sulphite in Aqueous Solutions.

K. S. G. DOSS, and (Miss) S. MENON, Karaikudi.

The polarographic reduction of sulphite in neutral and alkaline aqueous media has been reexamined based on data reported by Lewis.

Delahay's theory of kinetic polarographic currents has been applied for the interpretation of the first wave in neutral and alkaline media. The mechanism of the electrode reaction has been discussed. The pH dependence of the wave height and the observed diffision current are examined in the light of the mechanism.

69. Studies on Alternating Current Polarography : Effect of Nature and Concentration of the Supporting Electrolyte.

N. A. RAMIAH and S. K. D. AGARWAL, Kanpur.

Variation in the wave-width of the alternating current polarograms ofCd^{++} (2 mM) was investigated with the following supporting electrolytes (*S.E.*) : (*a*) KCl, (*b*) KBr, (*c*) KNO_3, (*d*) NaCl, (*e*) NH_4Cl, (*f*) $(NH_4)_2SO_4$, (*g*) NH_4NO_3, etc. The polarograms were sharp with *a*, *d* and *e*. Change in the concentration (*C*) of S.E. altered the wave-width, upto 1 molar concentration with a minimum at 0 25 M; increase of *C* beyond 1 M of *S.E.* did not result in a change in the wave-width of the polarograms.

70. Polarographic Reduction of Pyruvic Acid

K. S. G. DOSS and (Miss) S. MENON, Karaikudi.

The application of Delahay's theory of kinetic polarographic currents as applied to the reduction of pyruvic acid has been examined. It is shown that the available data can be interpreted more satisfactorily on the basis that the current is controlled by the rate of the reaction between pyruvate ion and water molecule forming pyruvic acid and hydroxyl ion than the other mechanism suggested by the earlier workers involving the rate of reaction between pyruvate ion and hydrogen ion, both from the point of view of the magnitude of the diffusion current as well as its pH dependance. The results give a clear indication of the latter reaction being sluggish due to the activation energy requirements.

71. Estimation of Serine residue in isoelectric proteins from potentiometric titrations with orthophosphoric acid:—Part I Gelatin.

J. K. BHAMBHANI and C. S. NARWANI, Bombay.

100 cc of 1% aqueous solution of isoelectric gelatin was titrated potentiometrically with 0·2 M solution of orthophosphoric acid at 26°C using H_2-electrode and saturated calomel electrode. The titration curve has two inflections, one at pH 2·78 and the other at pH 2·55; the first is attributed to combination of the acid at $-NH_3+$ of the protein and the second to the esterification of $-OH$ group of the serine residue of the protein. The equivalent weight of gelatin calculated from the gram equivalents of the acid combined with one gram of gelatin at pH 2·78, i.e. 1239. At pH 2·55, $119{\cdot}0 \times 10^{-5}$ gram equivalents of the acid are combined with one gram of gelatin while at pH 2·78, $80{\cdot}71 \times 10^{-5}$ gram equivalents are combined; the difference $38{\cdot}3 \times 10^{-5}$ gram equivalents of the acid is taken to be combined with $-OH$ group of the serine residue. The acid at both these pH values is found to ionise as mono-basic. So each gram equivalent of the acid

represents a gram molecule. Therefore, 38·3 gram molecules of the phosphoric acid are combined with 10^5 grams of gelatin. Since one gram molecule of phosphoric acid can combine with one gram molecule of serine, it is concluded that 38·3 gram molecules of serine residue are present in 10^5 grams of gelatine. The value of serine residue in collagen, the anhydride of gelatin formed by oxidation of the hydrolysate with periodic acid as described in "Chemistry and Biology of proteins by Felex Havrowitz" is 33·0 moles per 10^5 gram protein.

72. Electrochemistry of Fluorides—Part IV, Electrolysis of Cadmium Fluoride.

A. N. KAPPANNA and E. R. TALATY, Nagpur.

Electrodeposition of cadmium from acid fluoride solutions has been investigated in detail. Decomposition, anode discharge and cathode discharge potentials, using platinum electrodes have been determined at 30°C.

Deposition of the metal on platinum and steel cathodes has been studied from acid fluoride solutions under a variety of conditions and in the presence of a number of inorganic and organic addition agents. While some of the addition agents like urea, glucose and gelatine improve the nature of the deposits considerably, the most effective addition agent from the viewpoint not only of getting good and good-looking deposits but deposits, of a non porous nature, valuable as protection against corrosion, has been found to be brucine.

The bath containing brucine addition agent has been studied in detail and the working conditions for satisfactory operation determined.

73. A Study of the Electrochemical Reduction of Sodium Bisulphite to Sodium Hydrosulphite Using Rotating Amalgamated Cathodes.

S. SAMPATH, R. VISWANATHAN, H. V. K. UDUPA and B. B. DEY, Karaikudi.

A study of the use of rotating amalgamated cathodes in the electrolytic reduction of sodium bisulphite to give sodium hydrosulphite is discussed in detail. The cell set up for the same is described. Results obtained using stationary and rotating cathodes have been compared and explained. The effects of various factors such as pH, temperature and concentration of bisulphite in the catholyte, current density and speed of rotation of the cathode, duration of electrolysis, addition of stabilisers, etc., on the current efficiency of hydrosulphite formation have been fully studied. Studies have also been carried out in an inert atmosphere, as well as by bubbling sulphurdioxide into the catholyte. Amalgamated copper cathodes become black and the current efficiency could not be maintained for long durations of electrolysis. This has been overcome to some extent by frequent replacements of the cathode.

74. Electrode Potential Studies in the Cathodic Reduction of Sodium Salicylate to Salicylaldehyde.

S. SATYANARAYANA and H. V. K. UDUPA, Karaikudi.

Cathode potentials in the electrochemical preparation of salicylaldehyde using amalgamated copper cathode have been measured both under rotating conditions as well as under stationary condition with stirring. Potential values indicate that the primary reaction is the discharge of sodium ions to form Na(Hg)x and that the reduction of salicylate ion is a secondary reaction. Addition of sodium bisulphite to fix the aldehyde should be done in stages and the products formed have no influence on the cathode potential.

75. Electrode Potential Studies in the Anodic Oxidation of Glucose.

S. SATYANARAYANA and H. V. K. UDUPA, Karaikudi.

Anode potentials in the electrochemical oxidation of glucose at graphite anode have been measured using (a) a rotating anode, (b) a stationary anode with an auxiliary stirrer and (c) a stationary anode without any stirrer. The anodic potential at (a) was steady and reproducible and at (b) and (c) erratic and irreproducible. Potential values indicate that the primary reaction is the discharge of Br^- to Br at the anode and that the glucose is oxidized by other secondary reactions. The anode polarisation was found to be small (a), even at fairly high current densities, thereby explaining the high current efficiency obtained at them.

76. Potentiometric Studies of Strong Electrolytes.

S. K. K. JATKAR and (Miss) VIJAYA JOGAL, Poona.

Study of the complex formation and double salt formation in solutions of uranium nitrate with potassium and ammonium nitrate by precision potentiometric technique has given strong inflections at stoichiometric ratios

$U^{4}+ : K+$ (or NH_4+) as

1 : n, n varying from 1, 2, 3, 4, 5, 6, 7 etc. continuously up to 27 and some more like 30, 32, 54, 64, 86, 110, 136, 172, 216.

These results would indicate the formation of a super lattice structure of ions in solution.

Study of the E.M.F. and temperature coefficients of the antimony, tungsten, platinized platinum, fresh platinum wire electrodes in a number of pH solutions shows that pH against E.M.F. gives a straight line relationship. Platinum electrode in air behaves as an oxygen electrode.

77. Dissociation Constants of Hydroxy Coumarins.

B. N. MATTOO, Poona.

Dissociation constants of three hydroxy coumarins have been determined spectrophotometrically. pH^{K} (therm.) at 25° for 5-OH. 4-Me coumarin is 8·26 for 6-OH and 7-OH analogues it is 9·14 and 7·80 respectively. In alkaline medium irreversible hydrolysis takes place. The 7-OMe. 4-Me coumarin resembles the parent compound in its reversible hydrolysis at alkaline pH. The 7-O.CO.CH_3 analogue simply hydrolyses to 7-OH.

78. Dissociation Constants of Umbelliferones.

B. N. MATTOO, Poona.

Spectrophotometric determination of the dissociation constants of some umbelliferone derivatives gives the following pK_a values at 25° in water :

6-Et, 4-Me, 8·01; 6-Cl, 4-Me, 6·10; 4-CH_3COO, 8·09, 8-Ac, 4-Me, 7·17; 8-Ac, 6-Et, 4-Me, 7·65; 8-Bz, 6·44.

These are examined in light of chemical constitution.

79. Studies on the Formation of Boric Acid—Polyol Complexes.

L. V. NABAR and B. N. GHOSH, Bombay.

The effect of a number of polyols upon the formation of boric acid—polyol complexes has been investigated polarimetrically, conductometrically, viscometrically and by the pH- method. The values for the complex formation are in good agreement with the previous workers only in cases when the reaction time exceeds four hours or more. It is found that the complex formation in some cases is either one (polyol) to one (boric-acid) or as two (polyol) to one (boric-acid) or even less. In case of compounds containing more hydroxyl groups, it is found that the ratio is one (polyol) to two (boric-acid). An attempt has been made to apply the Debye-Hückel equation.

80. Studies on the Electrochemical Behaviour of Chromous Ions. Part I. Redox Potential Values of the System Cr++=Cr++++e in Presence of Acids, Weak Bases and Neutral Salts.

K. M. ABUBACKER and WAHID U. MALIK, Aligarh.

The variations of the redox potential values of the system $Cr^{++} = Cr^{+++} + e$ with dilution and on the addition of acids and their salts were studied. It was observed that (i) The potential of the original solution increases with dilution, (ii) The presence of anions like chloride and sulphate have very little influence on the potential of the system; cations like Na^+ and K^+ too do not influence the system. (iii) Additions of acids brings about a decrease in potential, but no regular relationship was found to exist between the pH and the potential of the system. On increasing the pH by adding sodium hydroxide, high negative potential is again observed.

The above observations may be explained either on the basis of the hydrolysis of chromous and chromic ions or on the existence of different iosmeric forms of Cr^{+++} ions. During hydrolysis $Cr(OH)_2$ and $Cr(OH)_3$ are formed, but since K for $Cr(OH)_3$ is larger $(6{\cdot}7 \times 10^{-8})$ then for $Cr.(OH)_2$ (1×10^{-17}) a high value of potential is observed. The three forms of chromic chloride in equilibrium may be shown as

$$\underset{(1)}{Cr(H_2O)_6Cl_3} \overset{H+}{==} \underset{(2)}{(Cr(H_2O)_5Cl)Cl_2} \overset{H+}{-=} \underset{(3)}{(Cr(H_2O)_4Cl_2)Cl}$$

Addition of more of H^+ ions would favour the formation of (3) with the result that lesser Cr^{+++} are released in solution. The colour of the solution also support this viewpoint.

The unexpected behaviour of the redox potential in presence of NaOH may be due to the amphoteric nature of $Cr(OH_3)$ and its subsequent transformation to CrO_2^- and CrO_4^{--} ions in basic medium.

$$Cr(OH)_3 + OH^- = CrO_2^- + 2H_2O.$$

$$Cr(OH)_3 + 5OH^- = CrO_4^{--} + 4H_2O + 3e.$$

Addition of the organic acids like citric and tartaric and their salts show a behaviour quite different from that observed in the case of mineral acids and their salts. This is due to their preferential complex ions formation with Chromous ions.

81. Studies of the Electrochemical Behaviour of Chromous Ions. Part II. The Influence of the Presence of Acids and Their Salts on the Utility of Chromous Ions as an Analytical Reagent.

K. M. ABUBACKER and WAHID U. MALIK, Aligarh.

The potentiometric titrations carried out for the estimation of chromous ions under different conditions of acidity, temperature and in presence of neutral salts,. lead to the following conclusions:

(i) The presence of both hydrogen and chloride ions are desirable for obtaining satisfactory results.

(ii) The equilance potential obtained in every case is higher than the theoretically expected value.

(iii) It is very difficult to obtain a very sharp break in the first stage of reduction of copper sulphate (Cu++ to Cu+). This is due to the unstable nature of Cu+ ions itself. The second break where Cr+ is completely converted to metallic copper is quite sharp even in the absence of any foreign ion like H+ or Cl− and hence this point should be taken for the calculation of the strength of $CrCl_2$.

(iv) Sulphate ions always oppose the tendency of giving a sharp break in potential at the equivalence point. Acetate ions also do not allow the reduction of Cu++ to proceed smoothly. The titration is not possible in presence of sodium acetate.

(v) Most satisfactory results are obtained when the medium in which the titration is carried contains a little H+ ions and sufficient amount of chloride ions. In presence of excess of chloride ions the breaks are not sharp.

(vi) The equilibrium is attained quite rapidly and stay breaks obtained when the titration is carried out at a higher temperature (60°C) and in presence of hydrogen ions.

(vii) The strength calculated for titrations against copper sulphate is always less than that obtained from $K_2Cr_2O_7$ in acid medium.

(viii) The strength of chromous chloride solution decreases on dilution.

82. Interaction of soils with charcoal.

BALWANT RAI PURI, TRILOKI NATH and LEKH RAJ SHARMA,
Hoshiarpur.

Titration curves of H-soils with K+-, Na+-, NH^+_4-, Ba++- and Ca++- charcoals and those of Na-soils with H+- and Ca++- charcoals have been studied in some details and it has been shown that the process results not only in lowering the soil acidity or alkalinity (as the case may be) but also in the transference of cations, from one surface to the other, accompanied by the evolution of heat. The titration curves are well defined and the end-points are well marked. The practical importance of these investigation has been pointed out.

83. Chemisorption of oxygen on Activated Charcoal and the sorption of acids and base.

BALWANT RAI PURI, D. D. SINGH, J. NATH and LEKH RAJ SHARMA,
Hoshiarpur.

Treatment of activated charcoal with oxygen at different temperatures, varying from 100 to 600°, was found to fix an appreciable amount of oxygen which, on desorption at 1200°, was given out as water, carbon dioxide and carbon monoxide. The total amount of chemisorbed oxygen as well as that disposed as carbon dioxide was found to be maximum at 400°. The amount and the nature of the disposition of the chemisorbed oxygen was found to depend upon the nature of the charcoal. The base-neutralising capacity of charcoal was almost entirely due to that part of the chemisorbed oxygen which on degassing at high temperatures was given out as carbon dioxide. The rest of the oxygen was not involved in base or acid adsorption by charcoal.

84. Conductometric and Thermometric studies on the Composition of Manganese ferrocyanide.

RAM SAHAI SAXENA, Kota.

The composition of manganese ferrocyanide has been investigated by conductivity measurements and by Dutoit's method of thermo-volumetry (J. Chim. Phys., 1922, *19*, 324) involving conductometric and thermometric titrations between $K_4Fe(CN)_6$ and $MnCl_2$ at several concentrations both by the direct and the inverse methods (i.e., when $K_4Fe(CN)_6$ from the burette was added to $MnCl_2$ seen in the conductivity cell or thermos flask and vice-versa). The conductometric and thermometric titration curves, both direct and reverse, yield only break at a point, where the molecular ratio of reactants, $K_4Fe(CN)_6 : MnCl_2$ is as 7 : 8, corresponding to the formation of a double salt $4Mn_2Fe(CN)_6.3K_4Fe(CN)_6$. The conductivity titrations were also carried out in presence of varying concentrations of alcohol, which improves the end point owing to the suppression of adsorption of the reacting ions, solubility of the precipitate and hydrolysis suffered by the ferrocyanide formed.

The formation of the double salt is in agreement with the results obtained by Britton and Dodd (J. Chem. Soc., 1933, 1543) who suggested the composition as $Mn_2Fe(CN)_6.XK_4Fe(CN)_6$, X being less than 1 and that the combination might be either physical or chemical. There is no indication of the formation of $K_2MnFe(CN)_6$ or $Mn_2Fe(CN)_6$ as reported in literature (Wyrubow, 'Liebig's Annalen der Chemie', (5) 8, 444 ; G. C. Stone and Von Ingen, J. Amer, Chem. Soc., 1897, *19*, 542).

85. Solid Liquid Equilibria in Solutions of Nonelectrolytes.

R. P. RASTOGI and K. T. Rama Varma, Lucknow.

Reliable solid-liquid equilibrium data for four systems have been obtained by the experimental method outlined previously [R. P. Rastogi and K. T. Rama Varma, J. Chem. Soc., London 2097 (1956)]. In view of the importance of solid-liquid equilibrium data for getting thermodynamic information (R. P. Rastogi and K. T. Rama Varma, Trans. Faraday Soc., 1957, in Press), the analysis of the data has been done. The experimental and ideal curves almost coincide for naphthalene-diphenyl system showing it to be very nearly ideal. Of m-nitraniline-m-dinitrobenzene and α-naphthol-β-naphthol, which are simple entertic systems, the latter is found to exhibit unsymmetrical regular behaviour. The phase diagram for m-dinitrobenzene-$_2$-napthol system is more complex and indicates the formation of an addition compound between the two components. The analysis reveals that the freezing point curve of the compound is approximately ideal and the heat of dissociation of the addition compound comes out to be 4·1 kcal/mole. A structure involving hydrogen bounding is assigned to the addition compound.

86. Studies on the Redoxokinetic Effect : Preparation of Reproducible Electrode Surfaces and Determination of 'α'.

U. H. NARAYANAN, K. SUNDARARAJAN and A. NARAYANASWAMI,
Karaikudi.

An experimental technique has been developed for obtaining a reproducible platinum electrode surface for measurement of the redoxokinetic potential Ψ. Reproducible values for the redoxokinetic potential for ferrous sulphate-ferric sulphate-sulphuric acid system at room temperature are reported, at frequencies of the a.c. field within the range 50-250 cycles/second. The value for 'α', the energy transfer coefficient has been calculated from the measurements of Ψ.

The effects of the circuit resistance, frequency within the range 50-250 cycles/second and of temperature on the value of Ψ have been studied and the results discussed in relation to the theory of the redoxokinetic effect.

87. Chemisorption Studies by Conductivity Measurements.

M. V. C. SASTRI and T. S. NAGARJUNAN, Kharagpur.

Chemisorption of N_2 on the n-type semiconductor ZnO, was studied by the change in the conductivity of the sample during chemisorption. The sample was sintered in vacuum for 8 hours at 500°C. The conductivity change with temperature was studied for a temperature range from −194°C to 350°C. The presence of N_2 was found to increase the conductivity at temperatures below 0°C but had quite the opposite effect on the conductivity at higher temperatures. Hence it is suggested that cationic chemisorption occurs at lower temperatures which changes over to anionic type at higher temperatures. This is confirmed by the *marked decrease* in conductivity observed at −194°C, when the system with gas at 200°C was brought down to −194°C.

88. Effect of Electrode Material on Organic Electroreduction.

L. I. ANTROPOV, Kharagpur.

A brief review is given of Russian papers devoted to the theory of electroreduction of organic compounds, the main points being as follow :

1. The role of null-point of metal in cathodic reduction of organic compounds; and
2. The mechanism of electrolytic evolution of hydrogen and organic electroreduction.

Experimental data are cited bearing out the assumption that adsorption of organic molecules and ions on the metal-solution interface is usually a necessary step of organic electroreduction.

The influence of null-point of metal on the surface concentration of organic compounds reduced and on the process of electroreduction is considered.

New effects are discussed connected with the position of null-point of metal (desorption limiting current, formation of bimolecular products of reduction).

Experimental data are given showing that electroreduction is dependent not only upon the value but also upon the mechanism of over-voltage. The probable nature of reducing agents on various cathodes is discussed.

Changes in the state of organic substances owing to changes in the composition of solution and their influence on the process of electroreduction are illustrated by several examples

Possibilities are considered of applying the theory elaborated by the author to solving various problems connected with electroreduction of organic compounds.

89. Effect of Ultrasonic Vibrations on the Iodine-Solvent Complexes.

N. R. SUBBARATNAM and A. K. BHATTACHARYA,
Jealgora and Sagar.

The complex between Iodine and Solvents in brown solutions have been variously described as polarisation complexes, Van der waals complexes and charge-transfer complexes. An attempt was made to see if there is any change in light absorption when these were subjected to ultrasonic vibrations. Iodine solutions in Ethyl alcohol, Methyl acetate, Dioxan, Nitrobenzene and Pyridine were studied. The more stable complexes are found undisturbed whereas the others show an increase in light absorption. An interpretation from the point of view of the disruption of the complexes appears plausible.

90. The Influence of ultrasonic Radiations on the Pseudoplasticity of Ferric Succinate Sols.

S. K. BOSE and S. P. MUSHRAN, Allahabad.

Freshly precipitated ferric succinate dissolves in succinic acid of suitable concentrations to give a deep red coloured sol of ferric succinate. The sol is positively charged and gives stable, transparent gels when coagulated with suitable electrolytes. The study of the viscosity of the sol under different shearing stresses indicates that it is pseudoplastic in nature. The sol was exposed for an hour to ultrasonic radiations from a Mullard generator with a power input of 50 watts producing 1 mega cycles per cent. It is observed that there is no marked change in viscosity immediately after irradiation. The irradiated sol is left undisturbed for 24 hours. The measurement of the viscosity of the aged irradiated sol shows that the viscosity and simultaneously the pseudoplasticity increases remarkably with age. It is concluded that the effect of the ultrasonic radiations is to weaken the adsorptive capacity of the colloidal surface leading to the desorption of the stabilising ions and a decrease of the electrical charge, so that the sol becomes more quickly unstable with the process of ageing and develops greater pseudoplasticity leading to a greater approach to gel structure.

91. Decomposition of Organic Halogen Compounds by Ultrasonic Waves—Part III-Mechanism of the Decomposition of Methylene Chloride in Aqueous Solutions.

SATYA PRAKASH and SATISH CHANDRA SRIVASTAVA, Allahabad.

Aqueous solutions of CH_2Cl_2 subjected to ultrasonic wãves (1-2 MC/S, 225 watts electrical input to the transducer) liberate chlorine (·0149 gm. atoms per gm. mole of CH_2Cl_2 in 3 hours) with the simultaneous formation of a yellow coloured solid. With longer exposures the liberation of chlorine does not seem to increase much. Pure undiluted CH_2Cl_2 fail to decompose by the waves. However, with dilution the liberation of chlorine increases and finally reaches a value 1·403 gm. atom per gm. mole of CH_2Cl_2 at ·1% approx. Considerable amount of bulk effect is observed. The decomposition is of zero order to a greater extent at both the frequencies tried and is favoured at the lower frequency. The reactions proposed are:

$$\mathrm{H.OH} \rightarrow \mathrm{H} + \mathrm{OH}$$
$$\mathrm{CH_2Cl_2} \rightarrow \mathrm{CH_2Cl} + \mathrm{Cl}$$

followed by hydrolysis and polymerisation.

92. The Abnormal Bond-Lengths in Organic Molecules.

LAKHBIR SINGH, Poona.

The shortening of the single-bond-lengths in conjugated molecules, such as diacetylene $(\mathrm{CH} \equiv \mathrm{C} \overset{1\cdot38}{-} \mathrm{C} \overset{1\cdot19}{\equiv} \mathrm{CH})$, cannot be due to 'resonance' or 'mesomerism' as the lengths of the multiple bonds are not increased. From the sequence of bond-lengths, C—C (1·54 A°), C=C (1·34 A°), and C≡C (1·20 A°), it is deduced that the double-bonded and the triple-bonded C-atoms possess progressively reduced atomic volumes. This sequence is then correlated with the number of σ-electrons in these C-atoms. Thus it is postulated that "the effective atomic volume of the C-atom in different states of combination depends upon its σ-electrol shell". The π-electron is regarded as forming a separate orbit outside the σ-electron shell, which fits in with other characteristic properties of the π-electrons. The volume of the σ-electron shell shrinks with the decrease in the number of σ-electrons in it. This concept explains the abnormal bond-lengths in conjugated molecules, the variations in the double-bond-length as in allene (1·30 A°), and also the changes in bond-lengths in saturated molecules.

93. Dielectric Constant and dipole Moment: Chromones.

S. K. K. JATKAR and C. M. DESHPANDE, Poona.

The dielectric constants and densities of 2, 6-dimethyl-γ-pyrone, 2-methyl-5-hydroxy-chromone and 2-methyl-7-methoxy chromone, have been measured at various concentrations and various temperatures. The dipole moments are deduced by applying the new equation and the values obtained are compared with the values calculated theoretically.

The moment values are : 2-6 dimethyl-γ-pyrone-3·78 2-methyl-5-hydroxy chromone-3·32-3·60, 2-methyl-7-methoxy chromone-3·61.

The dipole moment of 2-methyl-5-hydroxy chromone is independent of concentration but varies with temperature. The dipole moments of the other two compounds are independent of both the temperature and concentration.

94. Solvent Effect in Opticals Rotation & Dipole Moments.

S. K. K. JATKAR and A. J. MUKUHEDKAR, Poona.

The rotatory dispersion and dipole moment for different concentrations in chloroform were determined. For calculating dipole moment new equation by Dr. S. K. K. Jatkar was used. The three physical properties, viz., optical rotation, dipole moment and density showed an abrupt change at the same concentration indicating the change in molecular species. The plot of μ Jatkar against $[M]^{37}_{546}$ was linear. This indicated that the same reason was responsible for the solvent effect in the case of optical activity and dipole moment. The formation of two complexes, viz., RC O. . . $CHCl_3$ and RC O, $2CHCl_3$, could be explained by the appearance of H-bond.

95. The Dipole Moments and Molecular Structure of Formyl and Acetyl Derivatives.

R. RAMAN, SUNDARESA SOUNDARAJAN and K. R. KRISHNASWAMI, Bangalore.

The study of the dipole moment and molecular structure of formyl and acetyl derivatives is of significant importance with particular reference to hyperconjugation. Compounds for which a study of dipole moments is being considered are the following acetyl and formyl derivatives : The esters, the amides, the amidoximes, the oximes and hydrazides. For the determination of the dipole moments of the few of the compounds under study, namely, acetaldoxime, acetoxime, formamidoxime, formhydrazide and acethydrazide, accurate measurements of dielectric constants using a heterodyne beat apparatus and densities by the Ostwald—Sprengel Pycnometer have been carried out for a series of concentrations of the above compounds in dilute solution at 35±0·01°C in dioxan. In the cases of acetaldoxime and acetoxime in dioxan because of the anamolous linear decrease of density in the mole fraction range of the solute 8×10^{-3} to 8×10^{-2}, the moments could not be calculated using the usual Hedestrand procedure. The observed moments in dioxan for formhydrazide, acethydrazide, and formamidoxime are 2·69D, 2·96D and 2·25D respectively. The observed moment of formhydrazide corresponds to a structure in which the NH_2 group lies to the right of the C-N bond whereas that of formamidoxime, corresponds to an imino structure. The higher moment observed of acethydrazide is due to hyperconjugation.

96. Role of Surface Tension of the Components of Intermolecular Mixtures in the Study of Hydrogen Bonding by Parachor Technique.

H. P. AGARWAL, Bhopal.

The method of determination of Parachor by Mixture law using extrapolation technique is reliable and effective for the study of Hydrogen bonding provided the surface tension of the components of the Mixture differ by more than 7 dynes/cm.

In case the difference in surface tension of the components is less than 7 dynes per cm. the parachor technique fails to detect even the formation of strong Hydrogen bonding between the associated molecules. It has also been confirmed that the lowering in Parachor value is not induced by the difference in the surface tension of the components but is actually due to the formation of Hydrogen bonding between the molecules.

97. Viscosity of Solution of Magnesium Sulphate in Dioxan-Water Mixture at 35°C.

P. B. DAS, P. K. DAS, and D. PATNAIK, Cuttack.

The measurements of viscosity of magnesium sulphate in 10%, 20%, 30% and 40% by weight of dioxan-water mixture has been carried out to verify the modified Jones and Dole equation as suggested by us (Curr. Sci. 1956, *25,* 337). The experimental data for 10% and 20% composition fit in well with the modified Jones and Dole equation whereas, for 30% and 40% composition mixtures the equation does not hold good. The weak electrolytic behaviour of magnesium sulphate due to ion association and incomplete dissociation arising out of the decrease in dielectric constant has been considered as the reasons for the non-applicability of the modified Jones and Dole equation. The constant 'B' has been seen not to be much affected by the change of composition of solvent mixture from 10% to 20%.

98. Viscosity of Solutions of KCl in Acetone-Water Mixture at 35°C.

B. SAHOO, P. K. DAS and D. PATNAIK, Cuttack.

The measurements of viscosity of potassium chloride in acetone-water mixture has been carried out to verify the modified Jones and Dole equation suggested by us (Curr. Sci. 1956, 25, 337) and also to explore the nature of 'B'. The dependence of 'B' on the composition of the solvent would show that 'B' depends upon the nature of the solvent. The present investigation comprises the study of the viscosity of KCl in 10, 20, 30, 40 and 50% composition of acetone-water mixture. The concentration of the electrolyte varies from 0·001N to 0·1N. Except for the 10% composition of the solvent, the experimental data fit in well with the modified Jones and Dole equation. In the 10% composition of the solvent 'X' becomes equal to unity.

A change in the gradation of the value of 'B' has been observed above 30% of acetone content in the solvent. This fact in our opinion can be taken to indicate that above 30% of acetone, the composition of the solvation sphere undergoes change in a different manner with the change of composition of the solvent than when the acetone content is below 30%.

99. The Effect of Viscosity on the Fluorescence Life-time.

K. K. ROHATGI, Berkeley, U.S.A.

The effect of viscosity on the mean life time τ of the fluorescein ion ($c=1{\cdot}0258\times10^{-4}M$) in KOH ($c=1{\cdot}28\times10^{-3}M$) has been determined by the phase-shift method of Rollefson and Bailey, later modified by Gwinn and Kromman, using incident radiation modulated at a frequency of 5·2 Mcs. The viscosity was varied by using (1) a series of water-glycerol mixture, (ii) homoglous series of primary alcohols and (iii) by varying the temperature.

In the water-glycerol series, the change in viscosity from 0·8990 cps. at 25°C to 1630·6000 cps. did not change the life-time to any appreciable extent. The value in aqueous soln. $= 6{\cdot}30 \times 10^{-9}$ sec. whereas that in the most viscous soln. $= 6{\cdot}19 \times 10^{-9}$ sec.

Following results were obtained by using 90% primary alcohols as solvents

Solvent			ζ cps. at 20°C	$\tau \times 10^{+9}$ sec.$^{-1}$
Ethyl alcohol	...	...	1·424	6·57
Propyl alcohol	...	...	2·275	6·40
Butyl alcohol	...	...	2·797	6·23

In this series the τ values show slight decrease with increase in viscosity.

The temperature was varied by heating the solution to 55°C and taking readings as the solution cooled down to room temperature. The temperature was measured by means of a copper-constant thermocouple, before and after each reading. A variation in temperature of 30°C produced practically no change in the mean fluorescence life-time of fluorescein ions at the concn. used:

$6{\cdot}38 \times 10^{-9}$ sec. at 55°C
$6{\cdot}29 \times 10^{-9}$ sec. at 28°C

The readings were accurate to within $\pm 0{\cdot}06 \times 10^{-9}$ sec. involving an error of about 8%.

All these results show that viscosity has no effect on the life-time of fluorescein ion in KOH solution at the concn. (10^{-4}M) used in these experiments. This concentration is much below the range where the concentration quenching begins. Hence there is no diffusion controlled process involved. The absence of any effect of temperature variation is interesting. Further work is in progress.

100. The Conductivity of Magnesium Sulphate in Dioxan-water Mixture at 35°C.

P. B. DAS, P. K. DAS and D. PATNAIK, Cuttack.

The measurements of the conductivity of Magnesium Sulphate in 10%, 20%, 30% and 40% composition by weight of dioxan-water mixture have been carried out at 35°C with a view to evaluate the equivalent conductivity at infinite dilution. The low di-electric constant of the medium coupled with the higher valency of the constituent ions justify Magnesium Sulphate in such media to be treated as an intermediate electrolyte. The method of extrapolation used by Shedlovsky and by Fuoss and Krauss have therefore been applied in evaluating equivalent conductivity at infinite dilution. The mean activity coefficient has been computed by the use of Debye-Hückel limiting expression. The results indicate that for 10% and 20% composition mixtures the values of the equivalent conductivity and the dissociation constant can be considered as reasonably correct. For higher composition mixtures, however, the values of equivalent conductivity at infinite dilution determined by these methods of extrapolation using calculated values of the mean activity coefficient are uncertain. The Walden's rule is also obeyed in case of 10% and 20% mixtures.

101. The Behaviour of Electrolytes in Mixed Solvents Conductance of Sodium Chloride in Dioxane Water Mixtures at 35°C.

P. K. DAS, Cuttack.

Conductance of sodium chloride in 10, 20 and 30% dioxane water mixtures have been measured. The data when examined in the light of the Onsagers equation indicated ion association in these mixed solvents. With the modified Onsager-Falkenhagen equation and a corresponding modification in the activity terms the dissociation constant K of NaCl in these mixed solvents were calculated. K(10%) = 1·121; K(20%) – 0·597, K(30%) = 0·247. The product of $a_0\gamma_0$ were approximately constant, suggesting that the effective size of the ions are not materially altered in these solvents. The mean distance of approach was also estimated with the use of the Bjerrum equation. This distance increased when the dioxane content in the solvent was increased from 10% to 20% but practically remained unaltered with increase of the dioxane content to 30%.

102. Liquid—liquid Equilibrium data of the Ternary System : Acetonetriole in and Ethyl Alcohol at 30° and 40°C ± 0·01°C.

K. C. PATEL, R. D. PATEL and S. A. PATEL, Vallabh Vidyanagar.

The equilibrium data for the ternary system: Acetonetriolein and ethyl alcohol at 30° and 40°C ± 0·01°C has been studied. The shape of binodal curve generally changes with increase in temperature, showing that when temperature is raised the solubility is higher and the separation zone becomes smaller at 40°C. The result of the extraction is also dependent on the slope of the tie-lines which varies according to the nature of the components. The relation of the interpolation of tie-line data proves to result in a straight line as suggested by Othmer and Tobias.

103. Studies on the Dissociation Constant of Berberin Hydrochloride.

S. S. MANELKAR, L. V. NABAR and B. N. GHOSH, Bombay.

The apparent dissociation constant of berberin hydrochloride has been determined potentiometrically at 30°C and its value is of the order of $4{\cdot}467 \times 10^{-5}$.

104. Studies on the Ionic Hydration.

S. D. SULE and B. N. GHOSH, Bombay.

A critical study of the literature indicates that the hydration numbers obtained by various workers using different methods often do not agree. Hence the need for reinvestigation and the recalculation of the hydration number is felt. The hydration number calculated on the basis of Ulich's model are found to be in good agreement with those reported by Mukherjee and Levy.

105. A Note on the Energy Equation for Fluid-film Lubrication.

D. K. SEN and B. N. GHOSH, Bombay.

The energy equation of Christopherson and Cameron and Woods were obtained by omitting terms of flow-work of thermodynamics. These terms were taken into account by Charnes, Osterle and Saibel and their equation was identical with the one developed by Cope from the dissipation function. However, the second group of terms of the complete equations can be transposed to the right hand side and by putting $t' = p + \rho$ ct and one would get the same relation as obtained by Christopherson and Cameron and Woods where t is replaced by t′. Similarly the corresponding equation in dimensionless quantities can be modified. Therefore the results obtained by Christopherson will be exact results and not approximate ones for t′ and p, whence the results for t and p can easily be deduced.

106. The Energy of Self Diffusion in Some Metals.

RAM GOPAL, Lucknow.

Similarity between the energy of activation of self-diffusion in some metals and their respective latent heat of sublimation, estimated for the case when the metallic binding is absent, is discussed. It is pointed out that the results appear to support the mechanism of self-diffusion suggested by Eyring.

107. Near Infra Red Spectra of Some Organic Compounds.

S. K. K. JATKAR and A. J. MUKHEDKAR, Poona.

The near infra red region has importance in the study of hydrogen stretching vibrations, their overtones and combinations with other modes of molecular vibrations. The absorption Spectra of O-chlorophenol in carbon tetrachloride at different concentrations has been studied. It was observed that Beers' law was not obeyed indicating cis-trans isomerism. The absorption band at 1·51 μ is due to intermolecular hydrogen bonding in trans-molecules. The bonds at 1·45 and 1·41 μ are due to cis & trans molecules respectively.

108. On the Ratio of Corresponding Raman Frequencies in a few Similar Inorganic Compounds.

J. R. SARAF and RAM GOPAL, Lucknow.

A brief study has been made of the ratio of the corresponding Raman shifts in a few typical and similar compounds, mostly halides of some elements. It is found that this ratio is constant for two compounds of the same type and that, in general, it increases in magnitude as one proceeds towards compounds of more complex nature.

It appears that this constant ratio bears some relationship with the molecular weights of the two compounds concerned.

109. Molecular Refraction of Ionic Solids.

S. K. K. JATKAR and M. V. KAULGUD, Poona.

The deviation from additivity of refraction in ionic solids has been accounted for by Fajans and Joos (Z. Phys. Chem. 1934, N24, 199) as being due to the electrostatic deformation of the individual ions in the field of the other ions. Herein an attempt is made to explain the divergences from the point of view of ion overlapping and ionic covalent resonance (Pauling—Nature of the Chemical Bond). The relevant ionic characters 'i' are deduced from crystal energy data, considering it to be arising out of an ionic contribution plus a covalent contribution. Calculations reveal that the method although sound for gaseous hydrogen halides, comes across a small anomaly of negative refraction contribution for one of the atoms. It is, however, found that wave-mechanical method of computing the same in addition to removing the above apparent anomaly gives better agreement.

INORGANIC CHEMISTRY

110. Complex Compounds of Bipositive Silver with Pyridine Carboxylic Acids. Part III. Argentic Compounds of Pyridine Tricarboxylic Acids.

BIRESWAR BANERJEE and PRIYADARANJAN RAY, Calcutta.

In continuation of the previous work on silver (II) complexes of pyridine mono and dicarboxylic acid it has now been possible to prepare the argentic complexes of some of the pyridine tricarboxylic acids, namely pyridine 2, 3, 6-; 2, 4, 5-; and 2, 4, 6-carboxylic acids.

Argentic complexes of all the three acids were obtained by the persulphate oxidation of silver nitrate in presence of the acid concerned. The argentic complex of pyridine 2, 3, 6-tricarboxylic acid forms a very unstable green compound. Pyridine 2, 4, 6-tricarboxylic acid gave two differently coloured complex salts, one chocolate and the other black, whereas the colour of argentic complex of pyridine 2, 4, 5-tricarboxylic acid is orange.

The properties of these complexes are more or less similar to those of the mono and dicarboxylic acid complexes. They are possibly represented by monomeric structure like that of argentic picolinate. X-ray powder photographs show that the black and chocolate modifications of the argentic complex of collidinic acid (2, 4, 6-acid) differ in their crystal structure. A consideration of the properties of the argentic complexes of pyridine mono, di-, and tri carboxylic acids indicates that the order of their stability can be represented as follows:

Complex (mono) > Complex (di) > Complex (tri).

111. Complex Compounds of Benzylbiguanide with Copper, Nickel, Cobalt and Chromium.

MANOJ M. RAY and PRIYADARANJAN RAY, Calcutta.

Benzylbiguanide has been used as a new co-ordinating ligand to study the effect of substitution in biguanide on the nature and stability of bi- and tervalent metal complexes. Benzylbiguanide sulphate has been prepared by refluxing together benzylamine, dicyandiamide and ammoniacal copper sulphate solution and decomposing the resulting copper complex with cold dilute sulphuric acid. Besides the anhydro. copper benzylbiguanidine and its salts like chloride, bromide, iodide, sulphate, nitrite, nitrate, chromate and dithionate, a blue copper monobiguanide complex has been isolated at controlled acidity.

The complex benzylbiguanide bases of nickel, cobalt and chromium, and also their sulphate and chloride have been isolated and their properties studied. Besides the usual tris benzylbiguanide complexes of cobalt (III) a heterochelate, dipyridino cobaltic bis-benzylbiguanide, has been isolated. It has, however, not been ascertained whether it has a cis or trans configuration.

All these complexes are more soluble in non-aqueous solvents, in distinction from those of simple biguanide. In its tendency to dissociate readily in aqueous solution into nickel hydroxide, nickel bis benzylbiguanide chloride, resembles the corresponding methyl and ethyl biguanide complexes.

112. The Formation and the Stability of the Chloro-complexes of Copper, Nickel and Cobalt by the Ion-Exchange Method.

ASIT KUMAR RAY and PRIYADARANJAN RAY, Calcutta.

It is generally known that copper, nickel and cobalt form more or less easily dissociable anionic complexes containing chlorine. Many of these chloro-complexes have also been isolated in the solid crystalline forms. Bjerrum has found that in solution copper (II) ion may give rise to the formation of two different anionic chloro complexes, $[CuCl_3\text{-}H_2O]^-$ and $[CuCl_4]^{=}$, with chloride ions, depending upon the concentration of the latter. The presence of chloro complexes of nickel and cobalt of the type $\underset{H_2O}{[NiCl_3]^-}$, $[NiCl_4]^{=}$, $\underset{H_2O}{[CoCl_3]^-}$, $[CoCl_4]^{=}$, have been indicated by Donnan and Bassett, Partington and others. It appears that the formation and stability of similar chloro-complexes of nickel and cobalt have not yet been studied by any physico-chemical method.

Following the method outlined by J. Schubert (J. Phys. & Colloid. Chem. 52, 340, 350, 1948) we have studied the formation and stability of the chloro-complexes of copper, nickel and cobalt, the results of which are presented in this paper. The equation $\log\ [\lambda o/\lambda^{-1}] = \log\ K + n\ \log\ (Cl)$,

where λo and λ are the distribution coefficients of the respective metals on the resin and in solution in the absence and in the presence of the complexing agent (here chloride ion),

K is the formation constant, and

n is the number of addendum to the metal ion in the anionic complexes,

was utilised for this investigation.

From the plot of $\log\ [\lambda o/\lambda^{-1}]$ versus $\log\ (Cl^-)$ straight lines were obtained, the slope and the intercept of which gave the values of n and K respectively.

In the present investigation the metal ions in solution (both bound and free) were estimated spectrophotometrically by means of diphenyl-rubeanic acid following the method developed by Rây and Xavier.

The present investigation indicated the presence of $[CuCl_3H_2O]^-$ at chloride concentrations (1-3 M). At lower chloride concentrations (0·4-0·9 M) $[CuCl_3.H_2O]^-$ ions dissociate appreciably into $[CuCl_2,\ 2H_2O]$. At still lower chloride concentrations the presence of cationic complexes are indicated.

Nickel and cobalt (II) ions form the same type of anionic chloro complexes $\underset{H_2O}{[NiCl_3]^-}$, $[NiCl_4]^{=}$, $\underset{H_2O}{[CoCl_3]^-}$, $[CoCl_4]^{=}$ with chloride ions. At lower chloride concentrations cationic complexes are present in solution.

The impossibility of indicating of the presence of $[CuCl_4]^{=}$, $[NiCl_4]^{=}$ and $[COCl_4]^{=}$ ions in solutions of lower copper, nickel and cobalt concentrations are indicative of the relative instability of the $[CuCl_4]^{=}$, $[NiCl_4]^{=}$ and $[CoCl_4]^{=}$ ions in aqueous solution. Only under conditions of relatively high copper, nickel, cobalt and chloride concentrations can the equilibrium reactions be displaced appreciably towards the formation of the above chloro complexes. These chloro complexes can be arranged in the decreasing order of their stability as follows :

$$[CuCl_4]^{=} > [NiCl_4]^{=} > [COCl_4]^{=}$$

$$Kc = 5{\cdot}96 \times 10^{-2},\quad Kc = 8{\cdot}41 \times 10^{-2},\quad Kc = 9{\cdot}17 \times 10^{-2}$$

$$[CuCl_4]^{=} \qquad [NiCl_4]^{=} \qquad [CoCl_4]^{=}$$

113. Spectrophotometric Studies on the Formation of Copper Paludrine Chelates.

ASIT KUMAR RAY and MANOJ M. RAY, Calcutta.

The formation of copper paludrine chelates which are sparingly soluble in water has been studied spectrophotometrically in aqueous alcoholic medium. Dissociation of these complexes into copper hydroxide is suppressed by the presence of excess of paludrine.

On gradual addition of alkali to a mixed solution of cupric chloride and paludrine hydrochloride, successive chelation takes place. From the marked change in the spectral profile of the solution *i.e.*, shift in the absorption maxima, it was found that the blue copper monopaludrine (660 mμ) is stable in the pH range (4·25 to 4·5) and pink copper bis. paludrine (540 mμ) in the pH range (6·75 to 8·00). From the optical densities at these pH ranges at which it can be reasonably assumed that the formation of the mono- and bis-complexes is complete in presence of an excess of ligand, extinction coefficient values were derived for the respective chelates. The copper paludrine equilibrium system which at any time comprises two coloured species, was then optically analysed since the optical density is an additive property, and the concentrations of the coloured components were obtained. The concentrations of other species were then calculated from a knowledge of the initial composition of the solution and the stoichiometry of the complex. The successive formations constants ($kf = 6{\cdot}67 \times 10^8$ and $kf_2 = 1{\cdot}316 \times 10^7$) compare fairly well with those obtained by Ray and Das Sarma by potentiometric titration. The acid dissociation constants of paludrine, redetermined potentiometrically in 50% alcohol-water mixed are: $ka_1 = 3{\cdot}89 \times 10^{-11}$ and $ka_2 = 5{\cdot}129 \times 10^{-3}$ (cf. $pk_1 = 10{\cdot}4$ and $pk_2 = 2{\cdot}3$, determined from the ultra violet absorption spectra by Gage, J.C.S. 221 (1949) in 2% aqueous acetone medium at 20-25°C).

114. Studies in Chelates of Ammonium Aurintricarboxylate with Bipositive Copper.

ANIL K. MUKHERJI and ARUN K. DEY, Allahabad.

The formation of a coloured chelate, having γmax at 540 mμ, between cupric ion and ammonium aurintricarboxylate has been reported. It has been concluded that only one complex having metal : reagent ratio of 1 :2 is formed in solution. The method adopted for the investigation has been Job's continuous variation method, using spectro-photometric and electrical conductance measurements. It has been observed that there is an increase in acidity on mixing the reactants, showing that hydrogen ions are liberated as a result of chelation. It has been suggested that chelation occurs between the phenolic oxygen and the adjacent carboxylic oxygen.

A method has been presented for the calculation of formation constant from spectrophotometric data and the value of K in the case of the chelate investigated has been calculated to be $2{\cdot}58 \times 10^{11}$. The free energy of formation works out to be $-9{\cdot}5$ K. cals. at 25°C.

115. Studies in Thorium—Ammonium Aurintricarboxylate Chelate: Physico-Chemical Investigation of the Composition, Structure and Stability.

ANIL K. MUKHERJI and ARUN K. DEY, Allahabad.

Ammonium aurintricarboxylate has been found to form a coloured chelate with tetravalent thorium. The chelate has λmax in the range of 530-540 mμ. The composition of the complex has been investigated by spectrophotometric and conductance measurements, using Job's method of continuous variation. The chelate has a composition of 1 :1 and is of the anionic type. The structure has been discussed and it has been suggested that chelation occurs between the quinoid oxygen and the adjacent carboxylic oxygen.

The value of formation constant has been determined to be $2{\cdot}1 \times 10^4$ and the free energy of formation works out to be $-6{\cdot}4$ K. Cals. at 25°C.

116. A Note on the Composition of Silver Citrate.

KRISHNA C. MATHUR and ARUN K. DEY, Allahabad.

The white precipitate obtained by the interaction of silver nitrate and disodium hydrogen citrate has been found to be Ag_3Cit. The soluble argentocitrate formed by dissolving silver citrate in an excess of citric acid is unstable in an alkaline medium and has been found to precipitate Ag_3Cit, by the addition of ammonium, sodium and potassium hydroxides, to the colourless complex. It has been concluded that silver citrate is formed by the replacement of carboxylic hydrogens by silver and that the hydroxyl hydrogens are not involved in the process of precipitation of silver citrate.

117. Structure of Alizarin—3—Sulphonate Chelates of Bivalent Metals.

ANIL K. MUKHERJI and ARUN K. DEY, Allahabad.

In the chelates of alizarin-3-sulphonate with bivalent metal ions, the chelate ring may occur at two different alternative positions. The metal ion may be chelated either by (*i*) a pair of phenolic oxygens, or (*ii*) a quinoid oxygen and *alpha*-phenolic oxygens. In this paper, the structure of the chelates has been discussed, from spectrophotometric evidence, and it has been concluded that structure involving (*i*) seems justified. The conclusion has been arrived at from a consideration of the shift in λmax, as determined by studies of metal chelates involving sodium alizarin-3-sulphonate.

118. Formation of Beryllium Chelates with O-Cresotic Acid: A Potentiometric and Conductometric Study.

S. C. TRIPATHI and SATYA PRAKASH, Allahabad.

The increase in hydrogen ion concentration of monosodium o-cresotate solution by the progressive addition of beryllium sulphate indicated the possibility of the formation of a complex and also the displacement of hydroxyl hydrogen of monosodium o-cresotate. In the mixtures of beryllium sulphate and monosodium o-cresotate mixed in 1 :2 or more mole ratios, two colourless complexes are formed, one at about 5·25 containing beryllium and o-cresotate in 1 :1 ratio and the other above pH 8·5 containing beryllium and o-cresotate in 1 :2 ratio which have been shown by the inflections and breaks at one and two equivalents of alkali in potentiometric and specific conductivity curves.

119. Studies in Complex Formation of Beryllium with 1, Hydroxy 2, Naphthoic Acid: A Potentiometric and Conductometric Study.

S. S. TRIPATHI and SATYA PRAKASH, Allahabad.

Beryllium forms chelates with 1, hydroxy 2, naphthoic acid. The fall in pH of monosodium 1, hydroxy 2, naphthoate by the addition of beryllium sulphate shows the liberation of hydroxyl hydrogen in the process of formation of the complex.

The inflection in potentiometric titration curves in all mixtures and break in specific conductivity curves of 1 :1 mixtures of beryllium sulphate and monosodium 1, hydroxy 2, naphthoate at one equivalent of alkali show the formation of a 1 :1 mole ratio complex of beryllium and 1, hydroxy 2, naphthoate.

In the mixtures containing beryllium sulphate and monosodium 1, hydroxy 2, naphthoate in the ratios of 1 :2 or more, the formation of another complex, containing beryllium and 1, hydroxy 2, naphthoate in 1 ;2 mole ratio, is observed.

120. Formation of Aluminium O-Cresotate Chelate: A Potentiometric and Conductometric Study.

S. C. TRIPATHI and SATYA PRAKASH, Allahabad.

There is increase in hydrogen ion concentration of monosodium o-cresotate on the addition of aluminium chloride solution. The increase in hydrogen ion concentration may be due to the displacement of hydroxyl hydrogen in the complex formation. In the potentiometric and conductometric titration curves of 1 : 1, 1 : 2, 1 : 3 and 1 : 4 mixtures of aluminium chloride and monosodium o-cresotate the inflections and breaks at one equivalent of alkali indicate the formation of a complex containing aluminium and o-cresotate in 1 : 1 ratio. The second inflection at three equivalent of alkali shows the precipitation of aluminium hydroxide.

121. Studies on the Composition of Zirconium Ferrocyanide by Potentiometric Method.

JAGDISH NARAIN GAUR, Jaipur.

Potentiometric titrations between zirconium sulphate and potassium ferrocyanide have been performed by mixing the two solutions at different concentrations. Titrations were performed in the presence of alcohol upto an extent of ten per cent. Ferri-ferrocyanide electrode in conjunction with saturated calomel electrode was employed to determine the E.M.F. The titration curves at all concentrations indicated the formation of $ZrFe(CN)_6$ complex. No variation in the end point was noticed by the addition of alcohol. This showed that zirconium ferrocyanide is a stable complex least affected by dilution.

122. Ammines of the Double Chloride of Copper and Cadmium.

P. C. SINHA and DHRUBMAN SINGH, Patna.

Ammonia complexes of the double copper cadmium chloride $CuCdCl_44H_2O$ (Prepared by Hauer's method) was prepared by heating the double chloride first in a current of dry HCl and then in a current of NH_3 till no further absorption of the gas took place. The analytical results corresponded with the formula $CuCdCl_4.10NH_3$. The compound loses, NH_3 at the room temperature and a lower ammine $CuCdCl_4.8NH_3$ could also be isolated

123. Studies on Complex Formation of Quinoline with the Perchlorates of some Bivalent Metals.

P. C. SINHA and B. N. SAHAI, Patna.

Complexes of Zinc, Cadmium, Mercury, Copper, Nickel and Cobalt have been prepared by the interaction of excess of quinoline with the perchlorate of these metals. The following compounds have been isolated:
$Zn(ClO_4)_2.3Qn.$; $2Cd(ClO_4)_2.5Qn.$; $Hg(ClO_4)_2.5Qn.$; $Cu(ClO_4)_2.3Qn.$ $Ni(ClO_4)_2.5Qn.$ and $Co(ClO_4)_2.4Qn.$ It will be seen that none of these complexes contain any water in the molecule. The composition of these complexes has been established by analysis. Their properties have been fully investigated.

124. Complex Chromic Fluoberyllates.—Part I.

AMIYA KANTI GHOSH and NIRMALENDU NATH RAY, Calcutta.

Although the simple and double fluoberyllates of mono and bivalent metals have already been extensively studied, the fluoberyllates of trivalent metals were not known in pure condition except a few cobaltiammines. The present investigation has been successful in the preparation of trivalent complex chromic fluoberyllate. The preparation and properties of an acid chromic fluoberyllates alum and its dehydrated product acid chromic fluoberyllate dihydrate together with a violet rubidium chromium alum, analogous to corresponding sulphate compounds have been studied. The main difficulty encountered in the preparation of fluoberyllates of other trivalent elements was due to unique stability of their complex fluorides which results in preference to the fluoberyllate salts. The fluoberyllate alums of the chromiums are violet in colour but it rapidly changes to green with time and also with the increase in temperature.

125. Fluoberyllates of Organic Bases.—Part I.

AMIYA KANTI GHOSH, Calcutta.

Organic bases like ethylenediamine, propylenediamine, benzidine, etc., produce salts with acids like hydrochloric, nitric and sulphuric etc. Free fluoberyllic acid analogous to sulphuric acid could not be isolated in a pure state. This investigation deals with the preparation and properties of ethylenediamine, propylenediamine and benzidine fluoberyllates. X-ray analysis proved that ethylenediamine fluoberyllate is isomorphous with the corresponding ethylenediamine sulphate. The thermal stability of ethylene-diamine fluoberyllate has also been studied by a thermobalance. The structure of fluoberyllate radical has been discussed from the standpoint of molecular orbital theory and the stability of such fluoberyllate with organic bases has been possible due to the predominately covalent nature of Be-F linkage in the fluoberyllate radical in spite of the tendency of beryllium to be precipitated as hydroxides in presence of the bases.

126. Fluoberyllates and Their Analogy with Sulphates.—Part XII. Complex Compounds of Zinc and Cadmium Fluoberyllates with Organic Bases.

AMIYA KANTI GHOSH and NIRMALENDU NATH RAY, Calcutta.

This investigation deals with the preparation and properties of complex compounds of ethylene-diamine, propylene-diamines, hexamethylene tetramine with Zinc and cadmium fluoberyllate. They closely resemble in the physical and chemical properties with the corresponding compounds with zinc and cadmium sulphates with these bases. It is interesting to have pure compounds of this type, because of the secondary hydrolysis of the fluoberyllate radical into beryllium hydroxide in presence of bases. It has been found that the propylene-diamine complexes of cadmium fluoberyllate could not be isolated but in that case propylene diamine fluoberyllate separated in beautiful crystals. The salts obtained were pure and were stable in nature.

127. Kinetics, Mechanism and Stereochemistry of Substitution in Complexes of Palladium (II).

K. K. TRIPATHI and D. BANERJEA, Jadavpur, Calcutta.

The successive rates of substitution of acid groups (Cl, NO_2) in trans-dichlorodiamminepalladium (II), dichloroethylenediaminepalladium (II), cis- and trans-dinitrodiamminepalladium (II) by a variety of reagents of widely different nucleophilic character like water, aniline, glycine, pyridine, thiourea, and hydroxide ion were fully investigated by following the change in conductance of the solutions with time (*cf.* Banerjea, D., F. Basolo, and R. G. Pearson, J. Am. Chem. Soc., in press). The results indicated that the reactions are of SN2 type and the rates decrease in the following sequence of the incoming groups:

hydroxide ion>thiourea>pyridine>glycine>aniline>water. This is also more or less the (decreasing) order of nucleophilic character of these groups (*cf.* Swain, C. G., and C. B. Scott, J. Am. Chem. Soc., *75*, 141 (1953).

The great dependence of the rate on the nucleophilic character of the incoming group, coupled with the fact that the cis- form was usually found to react faster than the corresponding trans- compound, as also the fact that trans-dinitrodiamminepalladium (II) reacts much slower than the corresponding dichloro complex are evidences to show that the trans-effect (Chernyaev, I. I., Ann. inst. platine (U.S.S.R.) *4*, 243, 261 (1926)) is of no significance in the complexes of palladium(II).

128. Some Organic Complexes of Ferric Iron.

B. P. GYANI and RAM KISHORE PRASAD, Patna.

If a little ferrous iron be introduced into ferric chloride solution, there is the possibility of following the changes in the concentration of the latter (*i.e.*, that produced by introducing complex forming agents) potentiometrically. It is found that 10 cc. of ·03 M. $FeCl_3$ can be titrated quite conveniently with such complex forming substances as N/10 sodium acetate, propionate, fluoride and citrate. No addition of ferrous ions was necessary since perhaps a little was formed by reduction. The titration curves were fairly steep in each case, showing that the complexes formed must be quite stable (one molecule $FeCl_3$ for three of each anion, except for fluoride). Ammonium thiocyanate showed a very large reduction in the concentration of ferric ions, with the first few drops of thiocyanate added and another meagre inflexion at 3 moles.

129. Complex Compounds of Cobalt (III).—Part II. β-Alanino Cobaltic Bisbiguanidinium Hydroxide and its Salts.

S. P. GHOSH and J. N. GUPTA, Patna.

β-alanino cobaltic bisbiguanidinium complex has been obtained by the aerial oxidation of cobaltous biguanidine in presence of β alanine. The complex cation was found to behave in the same way as that of the dipyridino cobaltic bisbiguanidinium ion. The alanino complex, however, did not change to μ-thiosulphato-tetrabisbiguanide-dithiosulphato-dicobalt as was the case with the diamino and dipyridino derivatives. A series of salts, viz., nitrate, chloride, iodide, oxalate as well as the hydrated base has been prepared and their properties studied.

130. Complex Compounds of Nickel and Copper with Ortho Phenylene Biguanide.

S. P. GHOSH and A. K. BANERJEE, Patna.

Complex compounds of nickel and copper with ortho phenylene biguanide have been prepared and their properties studied. Besides the complex hydroxides, a number of salts, namely, chloride, bromide, iodide, sulphate and nitrate have been prepared. In case of nickel, the complex hydroxide has been obtained in three different colour modifications. The chloride and the sulphate have been obtained in two different modifications only. The copper complex, however, did not show any such modification due to the "size factor" of the coordinating molecule.

131. Complex Compounds of Copper and Nickel with n-Propyl Biguanide.

S. P. GHOSH and S. K. KARMAKAR, Patna.

Complex compounds of copper and nickel with *n*-propyl biguanide have been prepared and their properties studied. Besides, the complex copper and nickel *n*-propyl biguanidinium hydroxides, a number of salts namely chloride, bromide, sulphate, have been prepared. The "Size factor" effect of the co-ordinating molecule was not very pronounced as the copper complexes did not exhibit any colour modification and in the case of nickel very slight difference in colour has been observed.

132. Lead Propionato Complex in Aqueous Solution.—Part I.

S. K. SIDDHANTA and S. N. BANERJEE, Kharagpur.

The composition of the complex formed between Pb^{++} and propionate ions has been found to be $Pb\ Prop.^{+}$, from a study of the equilibrium hydrogen ion concentrations in mixtures of equimolecular lead nitrate and propionic acid solutions, by "Job's method of continued variation", using a new index property *viz.*, the increase of hydrogen ion concentration.

The value of the thermodynamic dissociation constant K, for the equilibrium $Pb\ Prop.^{+} \rightleftharpoons Pb^{++} + Prop.^{-}$ has been found out as $4{\cdot}57 \times 10^{-3}$ at 28°—30°C, by the direct application of "law of mass action", taking into account the activity coefficients of the individual ions, calculated from the ionic strength of the solution mixture of lead nitrate and propionic acid solutions, employing the "Debye Hückel limiting law".

133. Lead Propionato Complex in Aqueous Solution.—Part II.

S. K. SIDDHANTA and S. N. BANERJEE, Kharagpur.

Bjerrum's method (Metal amine formation in aqueous solution, P. Hasse and Sons, 1941) for determining the values of successive constants in step equilibria is eminently suitable where the ligand is neutral, while it is not so, where the ligand is charged. Suitable modifications have been introduced in the present paper to adopt this method in the case of charged ligand, taking into account the activity coefficients of the individual ions present in the solution, calculated by the application of "Debye Hückel limiting law" from the value of the ionic strength of the solution mixture.

In this work the pH values of aqueous solution mixtures of lead propionate and nitric acid at different concentrations, after attainment of equilibrium, have been determined; and applying the above modification of Bjerrum's method, the thermodynamic dissociation constants K_1 and K_2 for the two successive equilibria, $Pb\ Prop._2 \rightleftharpoons Pb\ Prop.^{+} + Prop.^{-}$ and $Pb\ Prop.^{+} \rightleftharpoons Pb^{++} + Prop.^{-}$ have been determined. The inapplicability of the "limiting law" to solutions at finite concentrations has also been properly considered, and ingenious corrections have been made in finding the values of K_1 and K_2 which are $51{\cdot}1 \times 10^{-3}$ and $4{\cdot}57 \times 10^{-3}$ respectively.

134. The System Mercuric Chloride—Thiourea—Water at 35°C.

S. K. SIDDHANTA and K. SWAMINATHAN, Kharagpur.

The phase equilibrium of the ternary system mercuric chloride, thiourea and water has been investigated by the "synthetic complex method" and the solubility data have been plotted as the isotherm at 35°C. In solution, thiourea was estimated by titration against potassium bromide-bromate solution and mercury by precipitation as its sulphide. The phase diagram shows the existence of five solid complexes of the following composition:

(*a*) $2HgCl_2.CH_4N_2S.H_2O$
(*b*) $HgCl_2.CH_4N_2S$
(*c*) $2HgCl_2.3CH_4N_2S$
(*d*) $HgCl_2.2CH_4N_2S$
(*e*) $HgCl_2.3CH_4N_2S$

The solid complexes, after the removal of the solution by repeated pressing with filter paper and air drying were also analysed for sulphur and mercury after Carius decomposition and the number of water molecules were fixed on the basis of this analysis considered in conjunction with graphical data. Of these complexes two (*b* and *d*) are reported in literature and the rest are described probably for the first time.

Investigations of equilibrium in certain other ternary systems involving thiourea are also under progress and the results will be communicated in subsequent papers.

135. Formation of Complex Compounds Between Uranyl Nitrate and Alkali Nitrates.—Part II. The System: $NaNO_3-UO_2(NO_3)_2-H_2O$.

S. S. GUPTA and C. S. PANDE, Lucknow.

In the previous parts of this series we have already shown the existence of three complex compounds in solution in the system: potassium nitrate-uranyl nitrate-water, while no such formation has been reported in literature in the system: sodium-nitrate-uranyl nitrate-water. Therefore it was of interest to extend the investigation to this system also. This paper reports the results obtained with the system: $NaNO_3-UO_2(NO_3)_2-H_2O$. The properties investigated were density, viscosity and conductivity. The methods employed were the same as described before.

The various values were then plotted against the concentration of uranyl nitrate. All the curves indicate two breaks at concentrations corresponding to the compounds: $NaNO_3.UO_2(NO_3)_2$ and $2NaNO_3.UO_2(NO_3)_2$.

136. Formation of Complex Compounds Between Uranyl Nitrate and Alkali Nitrates.—Part III. The System: $NH_4NO_3-UO_2(NO_3)_2-H_2O$.

C. S. PANDE and S. S. GUPTA, Lucknow.

In continuation of the work described in Parts I & II, of this series we report the results obtained with the system: Ammonium nitrate-uranyl nitrate-water. Measurements of conductivity and viscosity of a series of mixed solutions of ammonium nitrate and uranyl nitrate have been carried out. The values on being plotted against the varying concentration of ammonium nitrate clearly indicate three definite breaks at places where the stoichiometric ratios between the two components are (1:1); (1:2) and (1:4) respectively. They are, therefore, attributed to the formation of the compounds corresponding to: (*a*) $UO_2(NO_3)_2.NH_4NO_3$ (*b*) $UO_2(NO_3)_2.2NH_4NO_3$ and (*c*) $UO_2(NO_3)_2.4NH_4NO_3$. Out of these, the first two compounds are already reported in the literature.

137. A Study on the Formation of Complex Compounds Between Bivalent and Univalent Salts in Solution. System : $HgI_2.KCN.H_2O$ and $Hg(CN)_2.KI.H_2O$.

R. C. AGGARWAL and R. C. MEHROTRA, Lucknow.

The complex salt which crystallises out from the following reaction mixtures (in the molar ratios indicated) corresponds in analysis to $KHg(CN)_2I$ in every case : $KCN.HgI_2$; $2KCN.HgI_2$; $KI.Hg(CN)_2$; $2KI.Hg(CN)_2$; $8KI.Hg(CN)_2$. However, from the system, $HgI_2.4KCN$, a complex salt $K_2Hg(CN)_4$ crystallises out.

Conductometric, electrometric and cryoscopic measurements of the systems : HgI_2-KCN-H_2O and $Hg(CN)_2$-KI-H_2O indicate the existence of the following complexes in solution : $K[Hg(CN)_2I]$, $K_2[Hg(CN)_2I_2]$ and $K_2[Hg(CN)_4]$.

The fact that from the systems : HgI_2-$2KCN$ and $Hg(CN)_2$-$2KI$, the complex $K[Hg(CN)_2I]$ gets crystallized, suggests that the complex $K_2[Hg(CN)_2I_2]$ indicated by physico-chemical measurements is unstable and gets converted into the more stable complex $K[Hg(CN)_2I]$ during the process of crystallization. Some indication for the existence of the complex $K[HgI_2CN]$ has also been obtained. A modified method for the estimation of iodide in the presence of cyanide has been worked out.

138. Complex Salts of Zinc, Cadmium and Mercury.—Part I. Preparation of Zinc Thiocyanate Diammoniate and Tetra Thiocyanato Diamonium Zincate.

A. K. AGARWAL and R. C. MEHROTRA, Lucknow.

A detailed study of the reaction between zinc oxide and ammonium thiocyanate has been made. It has been shown that the reaction between ammonium thiocyanate and zinc oxide gives either zinc dithiocyanate diammoniate $Zn(CNS)_2 2NH_3$ or tetrathiocyanato diammonium zincate $(NH_4)_2Zn(CNS)_4$ according to the conditions employed. Conditions under which each can be obtained in a pure condition have been worked out and it has been shown that the two derivatives can be converted into each other.

139. Complex Salts of Zinc, Cadmium and Mercury.—Part II. Preparation of Cadmium Thiocyanate Diammoniate and Tetra—Thiocyanato Diammonium Cadmiate.

A. K. AGARWAL and R. C. MEHROTRA, Lucknow.

The reaction between cadmium oxide and ammonium thiocyanate has been studied in detail. It has been shown that the reaction of cadmium oxide with a dilute solution of ammonium thiocyanate yields a white powder corresponding in analysis to $Cd(CNS)_2Cd(OH)_2$. However, a concentrated solution of ammonium thiocyanate when treated with cadmium oxide gives rise to a product corresponding in analysis to $Cd(CNS)_2\ 2NH_3$. This product is hydrolysed in dilute solutions giving the same powder $Cd(CNS)_2.\ Cd(OH)_2$ as obtained above. Provided the molar ratio of NH_4CNS : Cd is greater than 4 and ammonia is evaporated off, the crystalline product obtained from the reaction mixture corresponds in analysis to a stable complex salt $(NH_4)_2\ Cd(CNS)_4H_2O$.

140. Complex Salts of Zinc, Cadmium and Mercury.—Part III. Preparation of Mercury Thiocyanate Diammoniate and Tri-Thiocyanato Mono-Ammonium Mercuriate.

A. K. AGARWAL and R. C. MEHROTRA, Lucknow.

The reaction of mercuric oxide and ammonium thiocyanate has been found to yield $Hg(CNS)_2 2NH_3$ and $(NH_4)Hg(CNS)_3$ according to conditions employed. The former appears to be an addition compound easily hydrolysed by water but the latter is a stable complex salt. Conditions have been worked out in which the above products can be interchanged into each other.

141. A Study in the Salicylic Acid Derivatives of Titanium.

I. D. VARMA and R. C. MEHROTRA, Lucknow.

The reaction of titanium isopropoxide with salicylic acid has been studied in refluxing benzene and the alcohol produced has been fractionated out azeotropically. It has been found that the reaction of titanium isopropoxide and salicylic acid in equi-molecular ratio displaces two moles of isopropanol, yielding a derivative corresponding in analysis to di-isopropoxy mono-salicylate of titanium, which has been isolated as an orange coloured solid highly susceptible to hydrolysis. In the presence of one further mole of salicylic acid, the reaction proceeds further with the precipitation of a deep chocolate red coloured di-salicylate of titanium. The di-salicylate of titanium is much less susceptible to hydrolysis and exhibits the remarkable property of solubility in aqueous ammonium solutions from which it is not precipitated even on warming.

142. Organic Compounds of Zirconium.—Part III. Study of Catechol Derivatives of Zirconium by Electrometric Titrations.

R. N. KAPOOR and R. C. MEHROTRA, Lucknow.

A study of the formation of catechol derivatives of zirconium has been made by pH measurements. It has been shown that the extent of chelation becomes greater with increasing pH of the solution. In acidic range, the results indicate the formation of a mono-catechollate derivative only even though the catechol may be present in a much higher molar ratio. The results further confirm the formation of derivatives of the type $K_2[Zr(C_6H_4O_2)_3]$ in solution and indicate that the maximum coordination number that zirconium can achieve by chelation with catechol is six. The formation of another new derivative $K[(OH)Zr(C_6H_4O_2)_2]$ is also indicated by these studies.

143. Organic Compounds of Zirconium.—Part IV. Study of Catechol Derivatives of Zirconium by Conductometric and Precipitation Methods.

R. N. KAPOOR and R. C. MEHROTRA, Lucknow.

A study of the formation of catechol derivatives of zirconium has been made by conductometric titrations and also by directly analysing the derivatives obtained under different experimental conditions. In conformity with the conclusions obtained from a previous electrometric study, it has been found that mainly mono-catechollate derivative is found when the solution is acidic (pH 1·6-5). The results further confirm the formation of derivatives of the type $K_2[Zr(C_6H_4O_2)_3]$ and $(NH_4)_2[Zr(C_6H_4O_2)_3]$ in solution and conductometric studies indicate that the maximum coordination number that zirconium can achieve by chelation with catechol in solution is six. Two new compounds $(NH_4)_2[Zr(C_6H_4O_2)_3]$ and $(NH_4)[(OH)Zr(C_6H_4O_2)_2]$ have been described and it has been shown that the composition of the derivatives obtained is also in conformity with the conclusions from physico-chemical measurements,

144. Attempted Preparation of Titanium Tetra-Acetate.

K. C. PANDE and R. C. MEHROTRA, Lucknow.

A survey of literature revealed that pure titanium tetra-acetate has not been described so far. With a view to prepare titanium tetra-acetate, the reaction of titanium tetrachloride and a mixture of acetic acid and acetic anhydride has been studied in detail. It has been demonstrated that the reaction yielded in cold pure crystalline titanium dichloride di-acetate, $TiCl_2(OAc)_2$. On refluxing titanium dichloride di-acetate in an excess of acetic acid-acetic anhydride mixture it initially dissolved giving a clear solution. On further refluxing, a thick white product was formed which on analysis was found to be a basic tri-acetate of titanium, $O\begin{matrix}Ti(OAc)_3\\Ti(OAc)_3\end{matrix}$. It has been, therefore, inferred that the reaction of titanium tetrachloride and acetic anhydride-acetic acid mixture is similar to that of titanium tetraalkoxide and acetic anhydride.

145. Reactions of Tetrachlorides of IV a Group Elements with Acetic Acid.

R. N. KAPOOR, K. C. PANDE and R. C. MEHROTRA, Lucknow.

The reaction of acetic acid with tetrachlorides of silicon, titanium, zirconium and thorium has been studied. The reaction of silicon tetrachloride with acetic acid appears to be straight-forward upto the formation of mono-chloro tri-acetate derivative, when further reaction becomes slow. In the case of titanium tetrachloride the reactions direct and straight-forward upto the formation of di-acetate product, when side reactions begin to take place yielding finally a mixture of basic di- and tri-acetates of titanium. The reactions of zirconium and thorium tetrachlorides yield the tetra-acetate products. While thorium tetra-acetate has been shown to be stable to heat under reduced pressure. Zirconium tetra-acetate decomposes to give basic di-acetate and acetic anhydride.

146. A Study in the Benzoic Acid Derivatives of Titanium.

I. D. VARMA and R. C. MEHROTRA, Lucknow.

The reaction of titanium alkoxides (ethoxide and isopropoxide) with benzoic acid has been studied in refluxing benzene. The reaction is straightforward upto the formation of di-benzoate derivates and has been confirmed by estimating the amount of alcohol collected azeotropically with benzene and also by analysis of the products. Tri- and di-alkoxy benzoates of titanium have been thus isolated. Further reaction of benzoic acid appears to be complicated and the tetra-benzoate could not be prepared by this reaction. The reaction of titanium tetrachloride and benzoic acid has been shown to be similar. Mono- and di-chloro benzoates of titanium have been isolated for the first time. Tetrabenzoate of titanium could not be prepared by this reaction also. The reaction between titanium tetrachloride and excess benzoic acid in presence of anhydrous ammonia has also been found to yield basic titanium di-benzoate only. The above findings are of special interest in view of similar observations already described for acetic acid reactions

147. Physico-Chemical Studies on Thallium Ferrocyanide Complex.

JAGDISH NARAIN GAUR and ABANI K. BHATTACHARYA,
Jaipur and Agra.

In continuation to our studies on the composition of metallic ferrocyanides by physico-chemical and analytical methods, the composition of thallium ferrocyanide has been studied by potentiometric, conductometric, and thermometric methods. Unlike the ferrocyanides of uranium and thorium, thallium ferrocyanide showed a greater tendency to dissolve in aqueous solutions. The precipitate dissolved in presence of the excess of either of the reagents viz., potassium ferrocyanide or thallium nitrate. No precipitate was formed in solutions of concentrations less than M/5. The formation of thallium ferrocyanide did not take place in the direct titration i.e., when thallium nitrate was added to potassium ferrocyanide solution. When the titrations were carried out in aqueous medium the observed titre values were slightly lower than the calculated equivalent, which gradually increased when the titrations were repeated in presence of alcohol.

In all the three physico-chemical methods, however, it has been established that the composition of thallium ferrocyanide corresponds to the formula $Tl_4Fe(CN)_6$ in concentrated solutions only.

148. A Study on the Formation of Complex Compounds Between Bivalent and Univalent Salts in Solution.—Part V.

R. C. AGGARWAL, Lucknow.

In Part IV of this series from a study of a number of physico-chemical properties of the system $HgCl_2$-KCl-H_2O it was shown that only two complexes are formed. Similar results were obtained in the system $HgCl_2$-NH_4Cl-H_2O. These investigations have now been extended to the system $HgBr_2$-KBr-H_2O. The physico-chemical properties conductivity, pH and freezing point depression have been studied of a series of mixed solutions prepared by the mono variations method and the results obtained were plotted as before when an influxion point corresponding to the formation of only one complex compound viz $K_2[HgBr_4]$ was obtained.

149. A Study on the Formation of Complex Compounds Between Bivalent and Univalent Salts in Solution.—Part VI.

Systems : HgI_2-KI-H_2O and HgI_2-$KCNS$-H_2O.

R. C. AGGARWAL, Lucknow.

The systems HgI_2-KI-H_2O and HgI_2-$KCNS$-H_2O have been studied from the preparative and the physico-chemical viewpoints. An evidence has been obtained for the existence of $KHgI_3.H_2O$, $K_2HgI_4.2H_2O$ and $K_2HgI_2(CNS)_2$ in the above systems by the synthetic method. The physico-chemical properties freezing point depression and pH have failed to detect the complex $KHgI_3$ because of its extreme instability in aqueous medium resulting in the failure of a mole of potassium iodide to dissolve a mole of mercuric iodide. The instability of $K_2HgI_2(CNS)_2$ in aqueous solution has resulted in the failure of this complex being detected by the cryoscopic and conductivity measurements Although these measurements do suggest an equilibrium of the type

$$HgI_2 + nKCNS \rightleftharpoons K_n[HgI_2(CNS)_n]$$

150. A Study on the Formation of Complex Compounds Between Bivalent and Univalent Salts in Solution.—Parts VII, VIII & IX.

R. C. AGGARWAL, Lucknow.

Just as between mercury halides and alkali halides, there existed a lot of controversy in the chemical literature regarding the exact number and nature of the compounds formed in the systems Cadmium halide-alkali halide-water; and hence a systematic investigation of these systems was undertaken. A series of mixed solutions for each system were prepared as before by the mono variation method. Physico-chemical properties employed were the same as for the system $HgBr_2$-KBr-H_2O above. On plotting the values of these properties against the concentration of the variant (potassium halide) evidence for the existence of two complexes, viz., $K[CdCl_3]$ and $K_4[CdCl_6]$ was obtained in the system $CdCl_2$-KCl-H_2O and of one complex each in the other systems.

The complex compound formed in the system $CdBr_2$-KBr-H_2O was found to be K_2CdBr_4 and an analogous complex in the system CdI_2-KI-H_2O.

151. Studies on the Composition of the Precipitate Formed by the Interaction of Copper Sulphate and Potassium-Cyano-Cobaltate II.—Part I. Some Physical Characteristics of the Precipitate and its Chemical Analysis.

A. AZIZ KHAN and WAHID U. MALIK, Aligarh.

Potassium-cyano-cobaltate II has got the property of forming insoluble metal-complexes. No systematic study seems to have been carried out to determine the composition of such compounds. The properties and composition of the precipitate formed by the interaction of copper sulphate and potassium cyano cobaltate II in the dried and the freshly precipitated state were studied.

The neutral complex was obtained by mixing equal volumes of equimolecular concentration of the reactants. Precipitates thus obtained and those by mixing excess of either of the two reactants were found to possess colloidal properties and have got gel-forming tendency. The phenomena of reversible adsorption by the precipitate for metal ions was also observed. Precipitate in the dried state was obtained by washing with water and alcohol and subsequent centrifuging. The complex was brought in solution both by acid extraction and alkali-fusion. Copper, cobalt and potassium were determined by photoelectric colorimeter and flame photometer while nitrogen was estimated by using a modification of the methods recommended by Kjeldahl, Colman. The composition was found to be $CuKCo(CN)_6H_2O$.

152. Studies on the Composition of the Precipitate Formed by the Interaction of Copper Sulphate and Potassium-Cyano-Cobaltate II.—Part II. Conductometric Studies on the Composition of the Freshly Precipitated Copper Cyanocobaltate II.

A. AZIZ KHAN and WAHID U. MALIK, Aligarh.

In continuation of our work described in Part I, the composition of the complex in the freshly precipitated state was determined conductometrically. Conductometric titration of potassium cobalto-cyanide and copper sulphate at different concentrations were carried out at 0°C in an atmosphere of nitrogen. Both direct (keeping copper sulphate in cell) and reverse methods were employed for these titrations.

In direct titrations conductivity continuously increases and a sharper end point is detected. The adsorption of potassium cyano-cobaltate II is very low since no change in the end point on the addition of alcohol to the solution could be observed. In reverse titrations the flat portion of the curve points towards the adsorptive capacity of the complex. This could be further confirmed by the titration results in aqueous alcoholic medium, where a decrease in titre value was obtained. However, sharp end points could only be found from the results of direct titrations.

On the basis of the result of direct and reverse titrations, the possible reaction taking place is :—

$$K_4Co(CN)_6 + CuSO_4 — CuKCo(CN)_6 + K_2SO_4.$$

The complex may be assumed to have the formula $K_2Co(CN)_6$.

153. Stability of Metal Complexes in Solution—I.

B. N. MATTOO, Poona.

A precise and general method of determining stability constants of metal complexes in solution involving stepwise equilibria, is described. The extinction coefficients of the complex species, or the free ligand concentration need not be determined experimentally. An alternative method, which is possible in special cases, makes use of the well separated equilibria resulting in various isobestic families of curves. Use is made of Varielle's data[1] in the application of these methods to the study of ferric-sulphosalicylic acid complexes.

154. Potentiometric Studies on the Composition of Silver Thiosulphate Complexes.

RAM SAHAI SAXENA, Kota.

The formation and composition of silver thiosulphate complexes has been studied by potentiometric titrations between $AgNO_3$ and $Na_2S_2O_3$ using silver indicator electrode. Only such titrations in which silver nitrate is used as the titre, give satisfactory results. A sharp fall in potential occurs at a point where the molecular ratio of reactants, $Na_2S_2O_3 : AgNO_3$ is as 1 : 2, corresponding to the formation of $Ag_2S_2O_3$. The curves are regular in form, a pronounced maxima in dE/dC is observed at the end point and the results are accurate and reproducible. The effect of alcohol and sodium acetate on the end point as well as on the nature of curves has been studied. In aqueous solutions the end point is reached a little earlier, error being about 1·5% which becomes almost negligible in presence of sodium acetate. Alcohol has, however, no appreciable effect on the end point. Addition of CH_3COONa improves the end point, although the magnitude of the break in potential decreases in its presence.

The inverse titrations, when $Na_2S_2O_3$ is used as the titre, do not give constant and steady values of E.M.F. There is, however, no indication of the formation of $NaAgS_2O_3$ as suggested by conductivity measurements (Jour. Indian Chemical Soc., 1954, *31*, 319).

155. Conductometric Studies on the Composition of Mercuric Ferricyanide Complex.

RAM SAHAI SAXENA, Kola.

The precipitation and composition of mercuric ferricyanide have been studied by conductometric titrations between $Hg(NO_3)_2$ and $K_3Fe(CN)_6$ at several concentrations both by the direct and the inverse methods. The direct titration curves yield two distinct breaks, the first one corresponding to the formation of $KHgFe(CN)_6$ which, on addition of excess of mercuric nitrate, changes to $Hg_3[Fe(CN)_6]_2$, the latter compound indicated by the second break. In the inverse titrations, when $Hg(NO_3)_2$ is used as the titre, only one point of intersection is observed suggesting the formation of $Hg_3[Fe(CN)_6]_2$. The effect of varying concentrations of alcohol on the end point has been studied and it is observed that at a concentration of 20% alcohol, the observed and the calculated titre values almost exactly coincide. This has been explained on the basis of adsorption of Hg(ous) and $Fe(CN)_6'''$ ions by the precipitated complex. Alcohol suppresses adsorption and hence a closer approach to the theoretical values is envisaged by the experimental results.

The formation of $Hg_3[Fe(CN)_6]_2$ has been confirmed by the results of E.M.F. measurements (Naturwissenschaften, *44*, 375, 1957).

156. Dissolution Studies of Arsenic Sulphides.

MAN HARAN NATH SRIVASTAVA and SATYESHWAR GHOSH,
Allahabad.

It has been found that the thiosalts are of great analytical importance, because many metals of the arsenic group are quantitatively precipitated as sulphides by decomposing their thiosalts with acid, and can be estimated in this way. But the chemistry of these reactions is still obscure, and attempts are being directed to elucidate the various reaction mechanisms involved therein. During the study of thioarsenites it has been observed that the study of the dissolution of arsenious sulphide forming thioarsenite is also necessary.

In the present paper the dissolution of arsenic tri- and penta-sulphides in alkaline hydrogen sulphide solutions has been studied systematically by analytical, conductometric, and potentiometric methods. The results indicate that the dissolution occurs mainly through the action of HS^- ions on these sulphides forming corresponding thioanions $(As^{III}S_4)^{5-}$ and $(As^{V}S_4)_3-$ respectively.

$$As_2S_3+5HS^- = 2(AsS_4)^{5-} + 5H^+$$
$$As_2S_5+3HS^- = 2(AsS_4)^{3-} + 3H^+$$

157. The Preparation of Anhydrous Ceric Oxy-Acetates.

D. PATNAIK and B. SAHOO, Cuttack.

The thermal decomposition of ceric acetate has been studied with exclusion of moisture and light. The two different compounds formed at 65° and 100° have been analysed. The analysis shows that the compound formed at 65° has a molecular weight of 652·8. This corresponds to the compound diceric mono-oxy hexaacetate having the theoretical molecular weight 650·2. At 100° a compound is formed the analysis of which gave a molecular weight 273·6. This corresponds to the formula mono ceric oxy diacetate having the theoretical molecular weight 274·1. These two anhydrous oxyacetates have been found to undergo rapid reduction to cerous state on exposure to moisture.

158. Preparation of the Formates of Rare Earth Elements.

B. SAHOO, S. PANDA and D. PATNAIK, Cuttack.

The formates of Lanthanum, Cerium and Thorium have been prepared by the action of respective nitrates with formic acid. The analysis of the compounds show that formates with 0·25 molecule of water have been obtained. The method of preparation is a convenient one and so may be adopted in the case of other rare earth elements. The estimation of the formates of these elements have also been discussed.

159. Polarographic Studies on Ethylene Diamine—Cadmium Complexes.

K. SRINIVASAN and R. S. SUBRAHMANYA, Bangalore.

Investigations on the polarographic behaviour of complexes formed by ethylene diamine with common metal ions have been undertaken employing different base electrolytes. The present paper deals with the complexes formed by cadmium.

The number of ligands of ethylene diamine attached to cadmium ion has been found to be three, when potassium sulphate is employed as the base electrolyte. When sodium carbonate solution is used as the base electrolyte variation in the concentration of sodium carbonate keeping the amine concentration constant, does not produce any significant shift in the half-wave potential. It has therefore been concluded that the carbonate group does not enter into the complex under these conditions. In presence of sodium hydroxide as the base electrolyte, however, variation of the sodium hydroxide concentration does produce a significant shift in the half-wave potential when the amine concentration is kept constant, only at low concentrations of the amine. From the shift in the half-wave potential it has been calculated that one hydroxyl group enters into the complex under these conditions.

160. Studies on the Complexes of Phosphorus Oxychloride with Aluminium Chloride.

K. N. VENKATARAMAN and K. R. KRISHNASWAMI, Bangalore.

The complex formation between aluminium chloride and phosphorous oxychloride has been studied and the results so far obtained show that the complex has the formula $2AlCl_3\ 3POCl_3$. The white crystals of the compound fume in air. Cryoscopic studies in nitrobenzene indicate a molecular weight of 726·8 which corresponds to the above formula. Conductivity measurements also corroborate the above results.

161. Peroxy Titanium Sulphate.

M. S. MOHAN and C. C. PATEL, Bangalore.

Spectral characteristics of peroxy titanium sulphate in dilute sulphuric acid and in absolute alcohol show that the absorption maximum shifts towards red with increase in the titanium concentration. Dissociation constants of the peroxy titanium ion at various acid concentrations indicate that it is less dissociated at higher acid concentrations. The Reisenfeld-Liebhafsky test on the complex shows that the peroxy oxygen is present as a true peroxide and not as hydrogen peroxide of crystallisation.

162. Studies on Manganese—Dioxide.

S. S. MANELKAR, N. R. KAMATH and B. N. GHOSH, Bombay.

Systematic investigations in this laboratory have shown that when manganese is present in aqueous solution as sulphate, nitrate, chloride or acetate, over 99·9% of manganese is precipitated by the Julian's method. Complete precipitation, however, is not obtained as indicated by the presence of traces of manganese which could readily be detected by conversion to permanganate ion. The minimum quantity of the oxidising agent and the nitric acid required for a definite amount of manganese in each case has been established. Precipitation with respect to the variation in concentration, temperature, pH and also the type and amount of oxidising agent are being studied at length. Activity of manganese dioxide are also being studied by the e.m.f. method in order to assess its suitability for the battery purposes.

163. Coprecipitation of Alkali with Hydroxides of Aluminium and Magnesium and Silicic Acid.

M. L. SEN GUPTA and U. P. BASU, Calcutta.

During precipitation, hydroxides of aluminium and magnesium, as well as silicic acid carry down quantities of alkali, and this has been studied for a number of cases where the products have importance for their acid adsorption and/or neutralisation capacity.

In the simplest case, the precipitation of aluminium hydroxide, in a condition relatively free from adsorbed compounds and readily soluble in dilute acids in the cold, has been considered. Under boiling conditions the precipitate is fairly pure but insoluble. Near about 80°C, the precipitate contains alkali the amount of which is not affected by ageing upto 60 minutes, although it loses solubility after ageing for 15 minutes. At 70°C, the extent of coprecipitation is increased, but is again independent of ageing upto 60 minutes when the precipitate still retains its solubility; on further ageing the amount of coprecipitation and solubility, both tend to fall off.

With magnesium hydroxide precipitated along with silicic acid, the extent of coprecipitation is negligible so long as the composition of the product conforms to the empirical formula $2MgO.3SiO_2$. With higher proportion of silica, as in $MgO.SiO_2$ or $MgO.2SiO_2$, the extent of alkali precipitation rapidly increases and corresponds to about 2 p.c. Na_2O in the last named product.

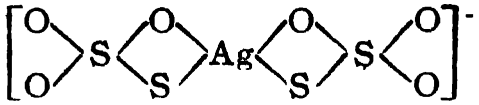
When alumina is introduced in the above, the coprecipitation of alkali proceeds to the partial exclusion of magnesia When sufficient alkali is provided for the complete precipitation of magnesium hydroxide, the extent of coprecipitation is so high that Na_2O may account for 3 to 16 p.c. of the product on ignited basis.

The implications of the above observations have been discussed in the paper.

164. Formation Constant of the Complex, and Free Energy, Enthalpy and Entropy Changes in the Formation of Argentothiosulphate by the Dissolution of Silver Bromide in Sodium Thiosulphate Solution.

ROSHAN LAL SETH and ARUN K. DEY, Allahabad.

On an investigation of the dissolution of silver bromide in sodium thiosulphate solutions at 30° and 50°C, it has been calculated that the composition of the complex ion formed in solution is $[Ag(S_2O_3)_2]^{---}$. The structure of the complex ion is represented by :



The co-ordination number of silver in the complex is four and the bond is, therefore, of the sp^3 type, suggesting a tetrahedral structure.

The formation constant has been calculated with the help of an expression derived and the values of pK are $2{\cdot}07 \pm 0{\cdot}12$ at 30°, and $2{\cdot}21 \pm 0{\cdot}10$ at 50°C. ΔF° or the free energy of complex formation works out to be $2{\cdot}28 \pm 0{\cdot}2$ K.cals at 30°C.

Knowing the value of K at two different temperatures, ΔH° has been calculated and the value of ΔS° with the help of the relation between ΔF°, ΔH° and ΔS°. The value of enthalpy is $1{\cdot}12 \pm 0{\cdot}14$ K.cals and that of standard entropy change $12{\cdot}5 \pm 0{\cdot}5$ cals/degree mol.

165. Some Physical Properties of Potassium Trichloromercuriate.

K. VISHWANATHAN NAYAR, Trivandrum.

Of the six complex compounds found to exist in solution, when mercuric chloride and potassium chloride solutions are mixed in different proportions, only two namely, K_2HgCl_4 and $KHgCl_3$ are found to crystallise from solution. They are stable as crystals only at temperatures far below 18°C. The Transport number of the mercury ion in $HgCl_2$ solution and also in a mixture of $HgCl_2$ and KCl solutions in the molecular ratio 1 : 2 and 1 : 1 respectively, have been determined. The results show that when mixed with KCl cationic mercury is converted into anionic condition, thereby showing complex formation. The instability constant of the $HgCl_3^-$ ion has been determined potentiometrically, using a concentration cell and silver chloride electrodes. The value obtained was $4{\cdot}7 \times 10^{-13}$. The value for the $HgCl_4^{--}$ ion being known to be $6{\cdot}0 \times 10^{-17}$, the results indicate that potassium trichloromercuriate is less stable than potassium tetrachloromercuriate.

166. On the Tscheffkinite from Orissa.

S. C. CHAKRAVARTY, R. K. DUTTA ROY and A. N. CHOWDHURY,
Calcutta.

Occurrence has been reported of the mineral Tscheffkinite, a titano-silicate of rare-earths, at Ganjam District, Orissa. The mineral has been analysed in details including spectrographic examination for trace constituents. The mineral contains 36·05%. Rare earths oxide and 2·8% Thorium oxide and 0·14% lead. The probable age of the mineral has been calculated by the Thromium-lead method which has been found to be $1{\cdot}27 \times 10^9$ years.

167. Selenium in India.

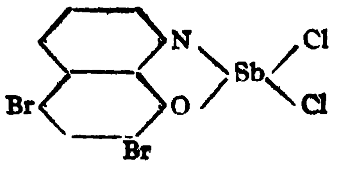
A. N. CHOWDHURY and R. K. DUTTA Roy, Calcutta.

Information on the occurrence and distribution of Selenium in India is scarce. A systematic investigation on this subject has been undertaken. A number of samples of sulphides of different metals have been studied. A detailed modified procedure has been worked out for estimation of Selenium in these materials. These samples have been decomposed with sulphuric acid-nitric acid treatment. Selenium has been separated by distillation from a bromine-hydrobromic acid mixture in a specially made all pyrex distillation apparatus. Selenium was estimated iodometrically. Three chalcopyrite samples have been shown to contain Selenium, the maximum Selenium content being 369 part per million. Sulphides of lead, zinc, antimony have been shown to be devoid of Selenium. One sample of natural sulphur from Baluchisthan was tested and Selenium was found absent. Further work is in progress.

167A. Dichloro-Antimony 5-7-Dibromo 8-Hydroxy Quinolate.

G. MOHAPATRA and S. PANI, Cuttack.

A beautiful yellow compound is obtained by adding small amount of 5-7-Dibromo 8-hydroxy quinoline to a saturated aqueous solution of antimony trichloride. The formation of the complex is completed by warming and the excess of antimony trichloride is removed by washing with Ether. The compound contains two Chlorine atoms, one 5-7-Dibromo 8-hydroxy quinoline nucleus per atom of Antimony and may be represented by the structure.



NUCLEAR CHEMISTRY

168. On the Study of removal of rare-earths and UX_1 from Uranium, Beryllium, Zirconium and Aluminium.

B. C. PURKAYASTHA and M. GANGULY, Calcutta.

An attempt has been made to remove rare-earths and UX_1 from uranium, beryllium, aluminium and zirconium. The major constituents in question containing rare-earths were taken in acetic acid solutions. Solid calcium oxalate mono-hydrate was added and it was then shaken for sometime. A decontamination of one part per million is easily achieved after two or three successive operations. The method can be claimed to be free from any complexities as mentioned in an earlier communication.

169. On the study of the Chemistry of Scandium on a Tracer Scale with Sc^{46} : Part I.

B. C. PURKAYASTHA and V. R. PAI VERNEKER, Calcutta.

It has been argued that earlier study relating to analogy of Scandium to transitional elements refers to co-ordinated compounds where the effect of the ionic radius of the central metal ion has less important a role to play. The object was therefore to study this analogy on crystallographic point of view, with simple salts. Coprecipitation of Sc^{46} with ferric sulphate has been studied. It has been found that in tracer concentration, scandium sulphate forms mixed crystals with ferric sulphate. Limitations of mixed crystal formation with reference to the concentration of scandium ion have been studied. Coprecipitation of tracer quantities of Europium and Yttrium has been investigated and it has been found that neither Europium nor Yttrium forms mixed crystals with ferric sulphate under identical conditions and that the carrying obeys Freundlich adsorption isotherm.

170. On the study of the Chemistry of Scandium on a Tracer Scale with Sc^{46} : Part-II.

B. C. PURKAYASTHA and V. R. PAI VERNEKER, Calcutta.

As an extension to our work on the chemistry of Scandium on a tracer scale, a study of coprecipitation of Scandium with potassium aluminium alum, aluminium sulphate and potassium sulphate was undertaken. The interest was to find evidence on the existence of Scandim alum by assuming that Scandium alum would be isomorphous with aluminium alum (potash). Investigation at different temperatures does not show any existence of Scandium alum. It has been found that aluminium sulphate does not carry any Scandium sulphate whereas iron sulphate has been shown to form mixed crystals with trace amounts of Scandium sulphate. This is a strong evidence in favour of the argument that Scandium is more akin to the iron family than to aluminium. Nature of the carrying of Scandium by potassium sulphate has also been studied as a supplementary to the whole system.

171. On the indirect application of Radioactive Nuclei in Analytical Chemistry. Part III.

B. C. PURKAYASTHA and SYAMAPADA DATTA, Calcutta.

As an extension to our work on radio-metric analysis, micro-determination of Zirconium and Phosphate with the help of P^{32} as a radioactive indicator was undertaken. Zirconium upto the order of about 1×10^{-6} gms. and phosphorus upto about 3×10^{-6}g. have thus far been estimated with reasonable accuracy. Results are always within statistical fluctuations.

Principle as reported in previous communications is to add excess of phosphoric acid (H_3PO_4; $H_3P^{32}O_4$) and the invisible zirconium phosphate is carried along with a few miligrams of AgCNS as carrier. The results indicate that in micro-determinations solubility factor can be totally annulled by the choice of a suitable carrier and estimation of γ order (10^{-6}g.) of elements can be accomplished within a very short time with radioactive reagents.

172. Study on the coprecipitation of rare earths with Calcium Oxalate Monohydrate.

B. C. PURKAYASTHA and S. N. BHATTACHARYYA, Calcutta.

In a previous communication (Jour. Ind. Chem. Soc. *34, 427* (1957) it was studied that Calcium oxalate monohydrate was a good coprecipitating agent for rare earth and thorium activities. The object of the present investigation was to study whether this coprecipitation is due to mixed crystal formation or due to adsorption. For this purpose $CaC_2O_4.H_2O$ was prepared, dried and pulverized. It was shaken in a solution containing tracer Yttrium (Y^{91}) and Calcium in acetic acid medium. The distribution coefficients were determined after equilibrium was established. It has been found that $CaC_2O_4.H_2O$ under the experimental conditions does not carry Yttrium through mixed crystal formation, as distribution coefficients (D) were not found to be constant. It is of interest to note that the carrying is in close agreement with Freundlich Adsorption Isotherm. The study on this aspect is still in progress.

173. Study on the coprecipitation of rare-earths with Calcium Oxalate precipitated from Homogeneous Solution.

B. C. PURKAYASTHA and S. N. BHATTACHARYYA, Calcutta.

In our previous communication the mechanism of uptake of rare-earth activities by Calcium Oxalate in a heterogeneous medium was studied. It has been shown that under the experimental conditions it follows Freundlich Adsorption Isotherm. It was, however, a study with preformed calcium oxalate monohydrate precipitate. The present investigation was undertaken with a view to study whether the same phenomenon occurs during slow precipitation of calcium oxalate from homogeneous solution.

Calcium oxalate was precipitated in about 3N acetic acid medium by oxalate ions slowly released by the hydrolysis of ethyl oxalate at the same temperature (40°C). Different fractions of calcium oxalate were collected at different intervals of time. Distribution of the tracer ions between the precipitate and the solution was studied. It was found to obey the logarithmic distribution law with a fair degree of accuracy. It can, therefore, be concluded that the mechanism of carrying during the course of precipitation is due to mixed crystal formation. As we have already studied in the previous communication that $CaC_2O_4.H_2O$ does not form mixed crystal with rare-earth oxalates, it is, therefore, evident from our results that during the precipitation process a series of higher hydrates are formed, one of which forms mixed crystals with the rare-earth oxalates in question. We are not yet certain which of the polyhydrates of calcium oxalate forms mixed crystals with rare-earth oxalates.

174. Kinetics of Isothermal annealing of Radiation damage in Szilard-Chalmers reaction with cobalt complexes : Part I—Tris Acetyl Acetone Co (III)—Section 3.

JAGDISH SHANKAR, AMARNATH and K. S. VENKATESWARLU,
Bombay.

γ-irradiation of cobaltic acetylacetonate, which has previously undergone (n, γ) reaction in solid state, was found to result in an increase in 'retention'. Isothermal annealing of these aliquots revealed the formation of metastable specie whose annealing rate is nearly independent of temperature. The original annealing rates as well as saturation values ($R\infty$) attainable at a particular temperature are decreased as a result of γ-irradiation.

Preliminary observations on X-irradiation also reveal similar effects.

175. Szilard-Chalmers effect in Sodium-Ethylenediamine-Tetra-acetate Cobalt (III).

S. B. SRIVASTAVA and RAMENDRA SHANKER, Bombay.

The retentivity shows a marked variation with change of conditions during dissolution in the neutron-irradiated sodium ethylene-diamine tetraacetate Co(III). Presence of metastable specie exhibiting moderately fast isotopic exchange with Co^{++} ions has been observed.

176. Anomalous behaviour of Pyridine as solvent in the study of the kinetics of Isotopic Exchange of Tris α-Nitroso β Naphthol.

JAGDISH SHANKAR, AMARNATH and S. B. SRIVASTAVA, Bombay.

It has been observed that employment of pyridine as solvent in the study of the kinetics of isotopic exchange between α-nitroso naphthol and cobaltous acetate, introduces two types of opposing errors of different magnitudes. Pyridine 'reduces' the complex, thereby introducing a negative error whereas the conversion of cobaltous acetate (most probably leading to the formation of a new complex of Co(III) with pyridine) to a higher oxidation state, adds to the numerical value of percentage exchange. It is suggested that the data of isotopic exchanges in pyridine are not reliable unless the rate of exchange is reasonably fast.

177. Kinetics of Isothermal Annealing of Radiation damage in Szilard-Chalmers reactions with Cobalt Complexes : Part I—Tris Acetylacetone Co. (III)—Section 2.

JAGDISH SHANKAR, AMARNATH and K. S. VENKATESWARLU,
Bombay.

Studies on the variation of conditions of irradiation effecting the retention and subsequent isothermal annealing behaviour of cobaltic acetylacetonate are reported. The initial retention appeared to be dependent on the conditions of irradiation, particularly, the γ-flux. Analysis of data reveals the existence of a fast annealing process whose rate is nearly independent of the temperature at which it is annealed. A gradual variation of the saturation values ($R\propto$) is also noticed.

The saturation value ($R\propto$) is found to be dependent on the previous thermal history of the aliquot.

178. A Radioactive Tracer Study of the adsorption of phosphate ions by aluminium oxide.

K. R. KAR, Delhi.

With a view to elucidate the nature of the adsorption of orthophosphate ions on aluminium oxide, exchange kinetics of these ions between phosphatised (tagged with P^{32}) alumina solid and inactive sodium phosphate in aqueous solution have been studied. Similarly kinetics of the exchange of phosphate ions between solid aluminium phosphate, tagged with P^{32}, and inactive sodium phosphate in aqueous solution have been followed. From the observed difference in the half times of exchange in the two cases e.g. seven and a half minutes in the former, and eighteen minutes in the latter, it is concluded that, in all probability, adsorption of phosphate ions on alumina is different from the chemical binding between aluminium and phosphate radicals in solid aluminium phosphate.

Observed evidence, however, is there to indicate that the quick process of adsorption on aluminium oxide is followed by a relatively slow process of diffusion of the phosphate ions into the interior of the micro-crystals of aluminium oxide.

179. Chemical shifts in Nuclear Magnetic Resonance of Mercury Compounds.

S. S. DHARMATTI, C. R. KANEKAR and S. C. MATHUR, Bombay.

The nuclear magnetic resonance of Hg^{199} has been observed in some mercury compounds by using a variable frequency N.M.R. Spectrometer. Chemical shifts ranging from ~ 5 to ~ 21 gauss have been observed. From the study of mercury nitrate there seems to be a possibility of observing shifts between mercuric and mercurous ions when combined with the same anion. The observed data has been discussed in the light of the physical and chemical properties of the compounds.

ORGANIC CHEMISTRY

180. Studies on the Alkaloids of *Rauwolfia fruticosa.*

NARAYAN ADITYA CHAUDHURY and ASIMA CHATTERJEE, Calcutta.

The crude alkaloid mixture isolated from the ethanol extract of the stem bark of *Rauwolfia fruticosa* was separated into two fractions: fraction I (weakly basic) and fraction II (strongly basic). Paper chromatography of fraction I using the n-butanol saturated with N/10 hydrochloric acid system indicated the presence of yohimbine (Rf, 0·77) and possibly ajmaline (Rf, 0·81). Paper chromatography of fraction II using the butanol : formic acid : water (12 : 1 : 7) system indicated the presence of serpentine (Rf, 0·61) and an unidentified alkaloid (Rf, 0·52). The alkaloids were located on the oven-dried papers (90°, 1 hour) by their ultraviolet fluorescence and also by spraying with Dragendorff's reagent.

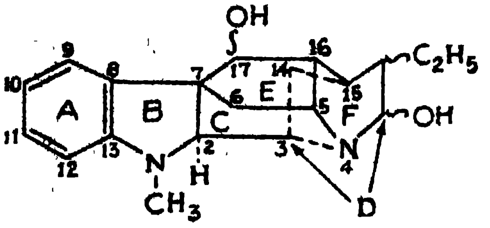
It was necessary to use known alkaloids as control references since Rf values varied with the amount of the material used and temperature. Further work on the isolation and characterisation of these compounds is in progress.

181. Studies on the Stereochemistry of Heterocyclic Compounds.

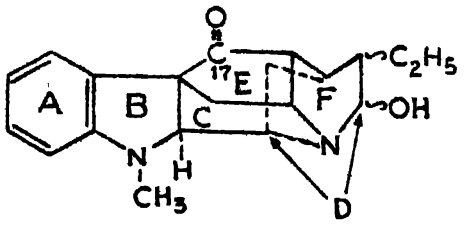
N. VENKATESWARAN and ASIMA CHATTERJEE, Calcutta.

Ajmaline, Ajmalidine, Serpinine and Rauwolfinine.

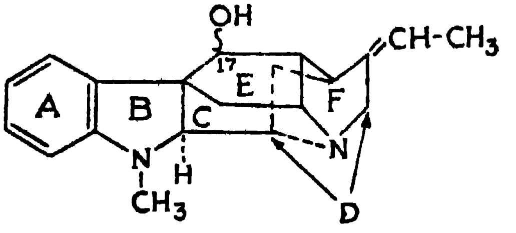
These alkaloids represent the typical indoline bases of *Rauwolfia* species. Conformational analysis (with Spring model) of these compounds (I, II, III and IV) (where the ring C has been assumed to have the stable chair form following the usual convention) has revealed several important informations about their stereo-configuration. These are reported below :



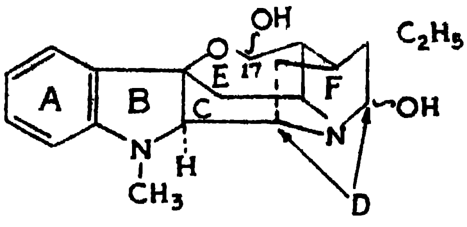
I. Ajmaline



II. Ajmalidine



III Serpinine



IV Rauwolfinine

(1) The rings B and C are translinked.

(2) Rings D and F possess only the boat conformation.

(3) Any substituent on rings D and F is found to be highly hindered, thereby showing some abnormal reactions.

In Rauwolfinine (III), the ring E is six membered containing additional oxygen atom. This ring should also adopt a boat conformation.

Rings D and F appear to hinder the approach of any reacting group to the indoline nitrogen atom. This may explain the suppressed basic character of indoline nitrogen viz., the negative formation of its acetyl as well of its salts with organic and mineral acids.

182. Chromatographic separation of conjugated unsaturated fatty acids (separation of elaeostearic acid).

S. K. PALIT, A. BANERJEE, B. T. R. IYENGAR and M. M. CHAKRABARTY,
Calcutta.

The separation of a conjugated unsaturated system has been studied to investigate the behaviour of elaeostearic (as methyl elaeostearate) acid towards chromatographic separation. A sample of Indian tung oil was used as the source, the mixed fatty acids of which were converted to the methyl ester. The adsorbent used was activated silica and solvents used for elution were petroleum ether and diethyl ether in different proportions. From the results it has been shown that the enrichment of elaeostearate over the initial depended on the adsorbent column height, and it is surmised that by using a richer source of elaeostearic acid and rechromatographing the richest elaeostearate fraction, an almost 100% elaeostearate could be obtained. Further work in this direction as well as the study of other conjugated dienoic, trienoic and tetraenoic systems is in progress.

183. Chemical investigation of the Stem-bark of *Xanthoxylum budrunga* wall.

NARAYAN ADITYA CHAUDHURY and ASIMA CHATTERJEE, Calcutta.

Xanthoxylum budrunga Wall [Fam : *Rutaceae*] is a well-known indigenous drug valued as a remedy for intestinal complaints and general debility.

The bark of *Xanthoxylum budrunga* procured from Dacca has been examined and the results are reported in this communication. Khastagir (Current Science, 1947, *16,* 185) isolated two crystalline coloured alkaloids from the alcoholic extract of the dried bark. Petroleum ether extract of the powdered stem-bark gave a greenish-white solid practically free from resinous matter. Chromatography of this solid, followed by crystallisation, gave colourless needles m.p. 212-13°, showing positive Liebermann's reaction and forming an acetate and a benzoate. The substance was identified as the triterpenoid alcohol, lupeol, by analytical and specific rotation-data and comparison with authentic specimens of lupeol and its derivatives.

184. Chemical investigations of the genus *Ficus* : Part II.

AJIT K. BANERJEE and P. K. BOSE, Calcutta.

From the bark of (1) *Ficus elastica* Roxb. (2) *F. heterophylla* Linn. (3) *F. benjamina* Linn. and (4) *F. retusa* Linn. the following neutral compounds were isolated and identified.

(1) α-Amyrin acetate, friedelin.

(2) α-Amyrin, α-amyrin acetate, β-sitosterol.

(3) and (4) β-sitosterol.

The yields varied from 0·01 to 0·2% and alkaloids were found to be absent.

185. Chemical investigation of *Daemia extensa* R. Br.

A. K. BARUA and S. PATTABIRAMAN, Calcutta.

From the plant *Daemia extensa* R. Br. (Fam. *Asclepiadaceae*) Dutta and Ghosh (J. Amer. Pharm. Assoc. 1947, 36, 250) reported the isolation of four sterols and three bitter principles, one of which was found to have actions on uterus comparable with that of pituitrin. The bitter principles could not, however, be obtained in a pure state, nor the sterols were characterised by them. In view of the important physiological action of the drug, a systematic investigation of the plant has been undertaken by us.

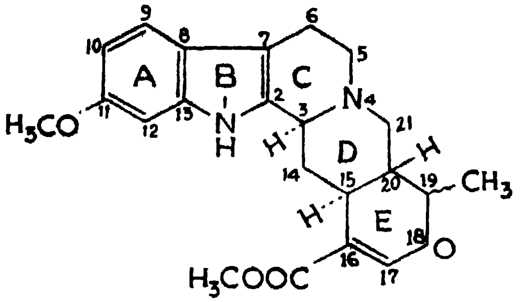
The petroleum ether extract of the whole plant, on chromatographic resolution over Brockmann's alumina, gave the following triterpene compounds: (i) α-amyrin acetate, m.p. 222-23°, $[\alpha]_D$ +79°($CHCl_3$), (ii) lupeol acetate, m.p. 215-16°, $[\alpha]_D$ + 42°($CHCl_3$), and (iii) lupeol, m.p. 211-12°, $[\alpha]_D$ +29·5°.

It appears that the sterols reported by the previous workers were probably not homogenous compounds but mixture of triterpenes. Further work is in progress.

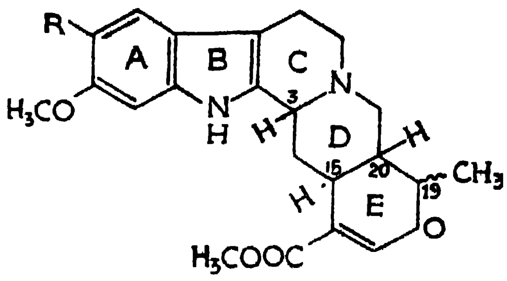
186. On the Stereochemistry of Rauwolfia alkaloids—Reserpinine, iso Reserpinine Tetraphylline and Reserpiline.

SUNIL KUMAR TALAPATRA, BHUPESH DAS and
ASIMA CHATTERJEE, Calcutta.

Reserpinine (I) and isoreserpinine (IIa) have been shown to be C_3-epimers, C_3-H in reserpinine possessing α-orientation [Djerassi *etal,* J.A.C.S., *79,* 1217 (1957)]. The stereochemistry of reserpinine at its ring junctures ($C_{15,20}$) and their relative configuration with C_3-H have been settled. The fact that reserpinine, like alstonine and tetrahydroalstonine [Chatterjee and Talapatra, Science & Culture, *20,* 568 (1956)], readily forms a crystalline D.N.P.H., m.p. 116° (dec.), with 2 : 4-dinitrophenyl-hydrazine suggests that in reserpinine rings D and E are *trans* fused and therefore it possesses *normal* structure, i.e., *syn-trans* configuration at C-3, 15 and 20 (I). Obviously, isoreserpinine would have *pseudo* structure, i.e., *anti-trans* configuration at these asymmetric centres (IIa).



I. Reserpinine



IIa R=H, Isoreserpinine
IIb. R=OCH_3, Reserpiline

Tetraphylline, a stereoisomer of reserpinine and iso-reserpinine, appears to be an alkaloid of the allo series (i.e. syn-cis configuration at $C_{3,15,20}$ as evidenced from the various experimental data available so far.

Reserpiline (IIb) is suggested to have *pseudo* or *epiallo* structure (i.e. C_3-H, β) from its I. R. spectrum [Wenkert and Roychaudhuri, J.A.C.S., *76,* 6417 (1956)]. Since this alkaloid produces a 2 :4-dinitrophenylhydrazone, the authors believe that reserpiline (IIb) is not an *epiallo* but a *pseudo* compound like isoreserpinine.

187. Isolation of Macrophylline from the Stem-Bark of *Alstonia macrophylla* Wall.

SARALNATH GHOSH and ASIMA CHATTERJEE, Calcutta.

From the stem-bark of *Alstonia macrophylla* Wall a non-nitrogenous compound, macrophylline, has been isolated besides some alkaloids. The molecular formula of the substance appears to be $C_9H_{8-10}O_3$. The compound is highly soluble in methylalcohol, ethyl alcohol and ethyl acetate, moderately soluble in chloroform, acetone and benzene and less soluble in ether. It is soluble in strong alkali from which the original compound can be regenerated upon acidification. The compound cannot be acetylated and does not produce any D.N.P. The compound undergoes certain changes in structure when refluxed with P_2O_5 in xylene. The I.R. absorption spectrum indicates the presence of a hydroxyl, a carbonyl function (probably conjugated) and an ethylenic unsaturation.

188. Hydrolysis of Chandrine.

BITHIKA BOSE, Calcutta.

The base chandrine, $C_{25}H_{30}N_2O_8$ isolated from *Rauwolfia serpentina* Benth undergoes alkaline hydrolysis with 30% w/v caustic soda at room temperature. Ethyl alcohol, volatile base, and a solid nitrogenous compound (M.P. above 300°C) have been isolated. The provisional formula for this solid product has been confirmed on analysis to be $C_{22}H_{27}O_8N_2$.

189. Attempts towards the synthesis of Wieland's C_{13}—Acid.

RANJIT KUMAR ROY, Calcutta,

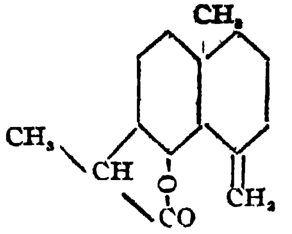
4-Acetyl-4-methyl pimelonitrile (J. Amer. Chem. Soc., 1942, *64*, 2851) was hydrolysed to γ-acetyl-γ-methyl pimelic acid with aqueous potassium hydroxide. Potassium hypochlorite oxidation of γ-acetyl-γ-methyl pimelic acid gave γ-carboxy-γ-methyl pimelic acid which on esterification with ethanol and sulphuric acid produced ethyl γ-methyl-γ-carbethoxy pimelate (b.p. 155-60°/0·6 mm.) in good yield. Ethyl 1, 3-dimethyl-3-carbethoxy-4-keto cyclohexane carboxylate (b.p. 145-48°/4 mm.) (II) was then obtained from ethyl-γ-methyl-γ-carbethoxy pimelate by Dieckmann cyclization followed by methylation *in situ*. The methylated Dieckmann product was then decarboxylated by refluxing for 12 hours with aqueous potassium hydroxide and the acid isolated therefrom after acidification was esterified *in situ* with ethanol and sulphuric acid to 2, 4-dimethyl-4-carbethoxy-cyclohexane-1-one (b.p. 105-10°/4-5 mm.). This keto-ester was then reduced with sodium borohydride in ethanolic solution to 2, 4-dimethyl-4-carbethoxy-cyclohexan-1-ol, which on treatment with p-toluenesulphonyl chloride and subsequent refluxing with collidine gave 2, 4-dimethyl-4-carbethoxy cyclohexene. Ozonolysis and subsequent ring-closure of the resulting product afforded an unsaturated keto-ester (b.p. 112-16°/6 mm.; D.N.P.H., red needles, m.p. 163-64°).

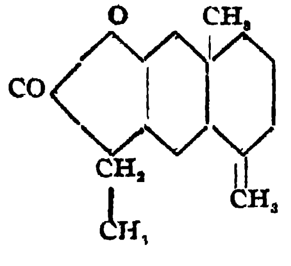
The product (II) was brominated and the bromo-ester was dehydrohalogenated with boiling collidine. The unsaturated keto-ester thus formed was allowed to react with hydrocyanic acid and the cyano keto-diester (b.p. 165-70°/0·6 mm.) was obtained in a moderate yield.

190. Constitution of the Saussurea Lactone, $C_{15}H_{22}O_2$.

N. R. GHOSH and P. K. RAMCHANDRAN, Calcutta.

The structure of a new crystalline C_{15}-lactone, saussurea lactone, isolated by Rao and Varma (J. Sci. & Ind. Research, 166, *10B*, 1951) from the roots of *Saussurea lappa*, C. B. Clarke, has been elucidated. Its molecular formula is $C_{15}H_{22}O_2$, melting at 146-47° and has the optical rotation of $[\alpha]^{D}$ 30° = +62·3°. Quantitative hydrogenation indicated the presence of one double bond. The analytical values of the dihydrosaussurea lactone m.p. 129° support the formula, $C_{15}H_{22}O_2$ for the original compound. The original compound has no ultra-violet absorption near 220 mμ and hence there is no αβ-unsaturated lactonic system in the molecule. In the infra-red studies, the saussurea lactone shows the well-defined band due to the saturated γ-lactone (5·65μ) as compared to (5·72μ) for an αβ-unsaturated γ-lactone. There is a weak band at 6·05μ indicating the ethylenic linkage. This band along with a band at 11·2μ can be ascribed to the presence of a (=CH_2) group in the original compound. The presence of the methylene group is confirmed by ozonolysis, the formation of formaldehyde being detected through condensation with dimedone. The keto-lactone, m.p. 135-36°, forms a yellow dinitrophenylhydrozone, m.p. 206°. The infra-red studies of the keto-lactone indicated the presence of the original γ-lactone and a saturated carbonyl band (5·8 μ) in a six-membered ring. On dehydrogenation with selenium at high temperature in a sealed tube, saussurea lactone afforded 1-methyl-7-ethylnaphthalene, identified by the mixed m.p. of its picrate m.p. 96° with that of an authentic sample. The structure of saussurea lactone may, therefore, be represented by either of the following two structures.





191. Friedel-Crafts Reaction involving unsaturated ketones and esters. Part V. The Study of the Friedel-Crafts Reaction between methylheptinone and benzene.

D. K. DATTA and N. K. BHATTACHARYYA, Calcutta.

6-Methyl-6-phenyl-heptan-2-one (I) obtained by the Friedel-Crafts reaction with benzene and methylheptenone was successfully reduced with lithium aluminium hydride and the resulting carbinol on cyclization gave a hydrocarbon which could be 1 : 1 :5-trimethyl-6 ·7-benzcycloheptane (II) and/or 1 : 1-dimethyl-4-ethyl-tetralin (III).

The ketone (I) on sodium hypobromite oxidation yielded 5-methyl-5-phenyl-n-caproic acid (IV) in good yield, which on cyclization with polyphosphoric acid furnished I : -dimethyl-6 :7-benz-cycloheptan-5-one (V).

It is expected that (V) on reacting with methyl magnesium-iodide and subsequent dehydration and reduction will furnish (II). The acid (IV) was esterified with ethyl alcohol as usual and the ester (VI) was degraded to 4-methyl-4-phenyl-n-valeric acid (VII) by Barbier-Wieland degradation. This acid is expected to furnish (III) by the successive cyclization, reaction with Ethyl Magnesium Iodide, dehydration and reduction Thus these authentic hydrocarbons (II) & (III) will be helpful for identifying and establishing the structure of the original hydrocarbon obtained by Friedel-Crafts reaction.

192. A new method for the synthesis of 8-Methyl bicyclo-(4, 3, 0)-nonane-4-one.

U. R. GHATAK, K. SEN and A. K. DAS GUPTA, Calcutta.

Methyl acetyl cyclopentene (b.p. 58-63°/7-8 mm.) was prepared from methyl cyclopentene through the action of acetic anhydride in presence of zinc chloride. The ketone so obtained was condensed with diethyl malonate according to Clemo and Dieckenson (J. Chem. Soc., 735, 1933) resulting in the formation of 8-methyl bicyclo-(4, 3, 0)-nonane-4-6-dione (m.p. 91-92°). The above diketone was converted to 8-methyl-bicyclo-(4, 3, 0)-4-keto-6-chloro-$\Delta^{5,6}$-nonene (b.p. 100°/1·5 mm.) on treatment with phosphorous trichloride in chloroform and the latter was reduced to the desired bicyclic ketone (b.p. 85°/3 mm.) in an excellent yield. The semicarbazone (m.p. 186°, lit. 185-86°) gave no depression in melting point when mixed with an authentic sample prepared according to Bagchi and Banerjee.

193. Synthetic Approaches Towards Bicyclic Diterpenoids.

SOUMYENDRA LAL MUKHERJEE and PHANINDRA CHANDRA DUTTA,
Calcutta.

Synthetic confirmation of the structure of Labdanolic acid and Eperuic acid deduced from analytical evidences (Cocker and Hallsal, J.C.S., 1956, 4259), is lacking. Attempts have been made to synthesise 1 : 1 : 10-trimethyl-6-keto-decalin which appeared to be the key intermediate of these bicyclic diterpenoids.

δ-(p-Methoxyphenyl)-γ, γ-dimethyl butyric acid (m.p. 68°), obtained through condensation of anisole with γ, γ-dimethyl-butyro-lactone, was cyclised to 4, 4-dimethyl-7-methoxy-tetralone (b.p. 130-135°/4 mm.) on heating with polyphosphoric acid. The ketone was reduced to 1, 1-dimethyl-6-methoxy tetralin (b.p. 90-93°/ 3 mm.) by zinc-amalgam. This was followed by the reduction of the aromatic ring by sodium in liquid ammonia to 1 : 1-dimethyl-6-keto-$\Delta^{5,10}$-octalin (b.p. 115-117°/ 6 mm.). But the conjugate addition of methyl-magnesium iodide failed under all experimental conditions so far tried.

In another approach, an important intermediate, 2 : 2 : 6-trimethyl cyclohexanone has been synthesised by a new method in a satisfactory yield. The condensation with β-chloro-ethyl-methyl ketone furnished 1 : 1 : 10-trimethyl-7-keto-$\Delta^{8,9}$-octalin (D.N.P.H.—m.p. 209·5°) in a poor yield. An alternative method for the preparation of the suitable hydroxylated bicyclic compounds has been developed. 1 :10-Dimethyl-2-keto-$\Delta^{1,9}$-octalin was methylated in good yield to 1 :1 :10-trimethyl-2-keto-$\Delta^{8,9}$-octalin (D.N.P.H.—m.p. 163°) which was reduced to the secondary alcohol and acetylated. The acetyl derivative was oxidised with tert. butyl-chromate to 1 :1 :10-trimethyl-2-acetoxy-7-keto-$\Delta^{8,9}$-octalin (D.N.P.H.—m.p. 248°).

194. Synthesis of γ-2-Carboxy-6-Methylphenylbutyric Acid—A Degradation Product of Picrotoxin.

BISWAJIT SINHA and P. BAGCHI, Calcutta.

Degradation of picrotoxin furnishes a dibasic acid $C_{12}H_{14}O_4$ to which Mercer, Robertson & Cahn (J. Chem. Soc., 997, 1935) assigned the structure of γ-2-carboxy-6-methylphenyl-butyric acid. This view has been confirmed by an unambiguous synthesis of the above compound.

Ethyl γ-2-methylbenzoylbutyrate prepared from the cadmium complex of o-bromotoluene and γ-carbethoxybutyroyl chloride was reduced by Huang-Minlon method to δ-2-methylphenyl-valeric acid. Cyclisation of the latter with polyphosphoric acid gave 1′-methylbenzcyclohepten-3-one. The latter on formylation followed by oxidation with potassium permanganate in alkaline medium furnished a dibasic acid having melting point 136°-136·5° (Lit. m.p. 135°-136°).

195. Synthesis of Bicyclic Compounds.

KALYANMOY SEN, and P. BAGCHI, Calcutta.

Cyclohexanone and cyclopentanone have been converted into the corresponding ethyl β-cyano-β-cycloalkenyl succinates through the Cope synthesis. These were then converted into ethyl γ, γ-polymethylene paraconates by hydrolysis and esterification. Partial hydrolysis of the latter gave β-carbethoxy-β-cycloalkenylpropionic acids which on cyclization and hydrolysis yielded bicyclo-(4-3-0)non-Δ8 :9 ene-1-one and bicyclo (3, 3, 0)oct-Δ7 :8-ene-1-one respectively. The former compound was obtained in good yield whereas the yield was unsatisfactory in the latter case.

196. Self-condensation of 3:4-Dihydrocoumarin.

J. N. CHATTERJEA, Patna.

Dihydrocoumarin is shown to undergo self-condensation with the aid of sodium hydride and the product has been converted into dichroman spiran (2 :2′).

197. Phenolic oxidation. Part II. Metal hydride reduction of Dehydro Bis (2-Hydroxy-1-Naphthyl)-Methane.

J. N. CHATTERJEA, Patna.

Dehydro bis (2-hydroxy-1-naphthyl) methane has been reduced with metal hydrides and the transformation of the products interpreted in terms of Pummerer's structure for the dehydro compound.

198. Phenolic oxidation. Part III. Structure of Abel's Abnormal Oxime.

J. N. CHATTERJEA, Patna.

Dischendorfer's supposed identification of an abnormal oxime isolated by Abel from dehydro bis (2-hydroxy-1-naphthyl) methane with 3 :4-6 :7-dibenzoacridone has now been disproved by a direct synthesis of the latter. Alternative structures for the 'oxime' are discussed.

199. Biogenesis of the Alkaloid Aspidospermine.

M. K. ROUT, Cuttack.

In the present communication, two biogenetic schemes have been formulated for the structure proposed by us for the dihydroindole alkaloid Aspidospermine (Jour. Amer. Chem. Soc., *79,* 1763, 1957). The first derivation is consistent with Woodward's biogenetic theory (Woodward R. B. Nature, *162,* 155, 1948) but is somewhat complicated, involving several steps. The second scheme however provides a much simpler and preferable picture for the biogenetic derivation of the alkaloid, though it involves the rather novel assumption that DOPA suffers typical ring cleavage but between its ortho and meta position to give a butylidenesuccidialdehyde equivalent.

200. Thiazole derivatives as Antispasmodics and Antihistaminics—Part III.

PRANABANDHU TRIPATHY, H. K. PUJARI and M. K. ROUT, Cuttack.

In the present investigation some 4-aryl-2-amino thiazoles prepared by the reaction of thiourea with appropriate ketones in presence of iodine, have been condensed with paraformaldehyde and one of the following (a) a ketone (several ketones have been used), (b) 1-phenyl-3-methyl-5-pyrozolone, (c) 8-hydroxy-quinoline and (d) diethylamine. This work was undertaken in the hope that the resulting compounds are likely to prove potential antispasmodics and antihistaminics. All the four series of thiazole derivatives have been screened for their antispasmodic and antihistaminic action in the S.C.B. Medical College, Cuttack, Orissa, and of these 4-aryl-2-(1′-phenyl-3′-methyl-5′-keto-4′-pyrozolinyl)-methyl-amino-thiazoles were found to possess significant antispasmodic and antihistaminic activity.

201. Action of unsaturated Ketones on Thiourea.

G. N. MAHAPATRA, Cuttack.

In the present investigation, the action of four unsaturated ketones on thiourea, in presence of iodine has been studied. It is peculiar that when unsaturated ketones are condensed with thiourea in presence of iodine, the thiazoles which result do not contain any unsaturation. The cause of the disappearance of the unsaturation has been investigated and an interesting mechanism of the condensation of unsaturated ketones has been arrived at.

202. Studies on 4′-acetyl sulfamoyl-phthalanilic acid.

S. L. LASKAR, S. ROYMAHASAY, P. R. GUPTA and S. L. MUKHERJEE, Calcutta.

The therapeutic activity of 4′-acetyl-sulfamoyl-phthalanilic acid (Phthalyl sulphacetamide) in the treatment of certain types of dysentery has long been known. During the course of our study with this chemotherapeutic agent, we noticed that a patent was taken by E. Heederson (B.P. 688, 776, March 19, 1952) in which p-phthalimide-benzene-sulfonamide was acetylated with large excess of acetic anhydride with potassium acetate as the condensing agent, and subsequently hydrolysed to phthalanilic acid. In our work we have observed that with the employment of a much less amount of acetic anhydride, the acetylation of p-phthalimido-benzene-sulfonamide can be effected in the presence of zinc chloride, p-toluene sulphonic acid, sulphuric acid etc. We have also observed that while the hydrolysis of 4′-acetyl sulfamoyl-phthalanilide to 4′-acetyl sulfamomyl-phthalanilic acid can be effected with dil. alkali in the cold, the reverse process of dehydration can be made in boiling acetic, propionic acid, and also in high boiling solvents like n-butyl alcohol, n-amyl alcohol etc. with a suitable water entrainer.

203. Action of Acidic Reagents on Ethyl α-Methyl-α-urethanyl-β-phenylpropionate.

T. N. GHOSH, Calcutta.

α-Methyl-α-amino-β-phenylpropionic acid (Ghosh, *et al.*, *J. Indian Chem. Soc.*, 1957, *34*, 417) has been esterified in presence of dry hydrochloric acid gas and the ethyl ester (I), generated from the ester hydrochloride, has been condensed with ethyl chloroformate to furnish ethyl α-methyl-α-urethanyl-β-phenylpropionate (II). Action of a mixture of phosphorus oxychloride and polyphosphoric acid on (II) has furnished (I) as the main product. However, when (II) is treated with phosphorus oxychloride, a neutral compound devoid of any ketonic property has been isolated. On hydrolysis with concentrated hydrochloric acid this gives α-methyl-α-amino-β-phenylpropionic acid. With hydrazine hydrate a hydrazide has been formed. On the basis of these properties, the compound has been formulated as 1 :4-dicarboethoxy-3 :6-dimethyl-3 :6-dibenzyl-2 :5-diketopiperazine (II), also supported by figures on analyses and molecular weight determination.

204. Experiments on the Synthesis of Coniferin.

DURGESHWARI PRASAD and D. N. CHOUDHARY, Muzaffarpur.

The glucoside, coniferin, was first isolated from the sap of the cambium of Coniferae by Tiemann and Haarmann (Ber., 1874, 611) who showed that the substance was a β-d-glucoside of coniferyl alcohol.

Hermann Pauly and Kurt Feuerstein (Ber., 1927, 1031-4) claimed to have synthesised the glucoside by biochemical methods, although they failed to synthesise it by purely chemical methods. Attempts are, therefore, made to synthesise coniferin by steps involving standard chemical reactions.

Thus, methyl ferulate, prepared by an improved method, was condensed with O-tetraacetyl-α-d-glucosidyl bromide in alkali-aqueous-acetone when the hitherto unreported methyl-3-methoxy-4-tetraacetyl-β-glucosidoxy cinnamate, mp. 140°, was obtained in good yield. Attempts to reduce the ester group of the foregoing compound with lithium aluminium hydride, with a view to obtain the corresponding alcohol (tetraacetyl coniferin), however unaccountably failed although varying conditions were employed. Further experiments are in progress.

205. Interaction of Phenyl—and p-Tolyl Thiourethanes with Aromatic Amines.

R. H. SAHASRABUDHEY and C. N. V. NAMBURY, Banaras.

Thiourethanes have been reported in smaller or greater yields accompanying the formation of aromatic disubstituted thioureas by the interaction of amines and carbon disulphide in presence of alcohol. This suggested the possibility of their being intermediate products. It has now been found that phenyl- and p-tolyl thiourethanes when directly treated with aromatic amines upto 100°C, no perceptible reaction takes place. At 180°C, with one hour's duration of heating, aniline and phenyl thiourethane (1 : 1 by weight) gave thiocarbanilide in 60% yields. Under similar conditions p-toluidine and p-tolyl thiourethane gave s-di-p-tolyl thiourea in 80% yields. Similarly phenyl thiourethane and o-toluidine gave over 70% of N-phenyl N'-o-tolyl thiourea and aniline and p-tolyl thiourethane gave 52% of N-phenyl N''-p-tolyl thiourea.

The reaction appears to be pretty fast at higher temperatures. For example. phenyl thiourethane and o-toluidine gave at 180°C, 30%, 45%, 52% and 72% of the corresponding thiourea in 5, 10, 15 minutes and two hours respectively. The same reactants at 140°C gave only 4% yield after five minutes heating.

206. Hydroxy Ketones Part IX. The synthesis of bactericides through Fries rearrangement.

G. S. SAHARIA, Delhi.

Klarmann established that chloro derivatives of hydroxy diphenylmethane are potent bactericides, there, however, did not exist a convenient method for their synthesis. A two step method has been evolved, which, it is hoped, would provide a simple route for the synthesis of such compounds. In the present communication, the esters of o-chlorobenzoic acids with phenol, isomeric cresols and naphthols were subjected to Fries reaction when the corresponding hydroxy ketones were obtained. These on reduction furnished the diphenymethane derivatives. It was observed that Clemmensen's method of reduction gave better yields over the Wolff-Kishner's method. Some of these are being investigated for their bactericidal properties.

207. Studies in the Oxidation of Alkylpyridines into Pyridine Carboxylic Acids.

S. K. SAHA, Calcutta.

Methods have been studied for preparation of isonicotinic acid from alkyl pyridines. Oxidation of 4-picoline by potassium permanganate has been modified to give improved yield. No oxidation took place with manganese dioxide and sulphuric acid as claimed by certain patent. Potassium or sodium dichromate with nitric or sulphuric acid has failed to produce any definite result under different conditions with or without the presence of a catalyst. However, oxidation of 4-picoline with nitric acid in presence of sulphuric acid has given encouraging results. The presence of catalysts like iron powder or better iron powder with trace of copper seems to accelerate the reaction.

208. Reactive Methylene Groups and Nitroso-Compounds.

B. N. MANKAD and M. R. PATEL, Vallabh Vidyanagar.

By interaction of (i) Acetoacetanilide and (ii) Acetoacet-o-toluidide with (a) p-nitrosodimethylaniline, (b) p-nitrosophenol and (c) α-nitroso-β-naphthol in ethanolic solution, the following nitrones have been obtained.

(i) Acetoacetanilide-2-(p-N-dimethylaminophenyl) nitrone.
(ii) Acetoacetanilide-2-(p-hydroxyphenyl) nitrone.
(iii) Acetoacetanilide-2-(2-hydroxynaphthyl) nitrone.
(iv) Acetoacet-o-toluidide-2-(p-N-dimethylaminophenyl) nitrone.
(v) Acetoacet-o-toluidide-2-(p-hydroxyphenyl) nitrone.
(vi) Acetoacet-o-toluidide-2-(2-hydroxynaphthyl) nitrone.

209. Studies on Allylmigration in Coumarins.

ASIMA CHATTERJEE and SUDHIR KUMAR SAHA, Calcutta

Allyloxy-coumarins and γ, γ-dimethylallyloxy-furocoumarins (allyloxy groups being substituted in the benzene nucleus) undergo Claisen rearrangement when heated to 170-200°. But γ, γ-dimethylallyloxy coumarins are found to behave otherwise. Upon thermal treatment or sublimation in high vacuum these compounds suffer degradation. γ, γ-dimethyallyl fragments are lost with the formation of hydroxy coumarins. If the reaction-temperature is kept below 170°, γ, γ-dimethylallyloxy coumarins remain unchanged. An increase in temperature by 10° results in partial decomposition of the compounds. Further heating of the substances to 200° completely eliminates γ, γ-dimethylallyl groups from the molecules. Similar observation has been made with geranoxy-coumarins.

210. Synthesis of 3:5-dichloro-2-hydroxy Chalkones and their derivatives.

B. C. JHA and G. C. AMIN, Ahmedabad.

The condensation of 3:5-dichloro-2-hydroxyacetophenone with (a) benzaldehyde, (b) 2-methoxy-, (c) 2-hydroxy-, (d) 4-methoxy-, (e) 4-hydroxy-, (f) 3:4-methylenedioxy-, (g) 3-methoxy-4-hydroxy-, (h) 3:4-dimethoxy and (i) 2-chlorobenzaldehydes in presence of alcoholic KOH gave 3′:5′-dichloro-2′-hydroxy chalkones. These chalkones were cyclised to the 6:8 dichloro flavonones by the action of dilute ethanolic hydrochloric acid. The oxidation of chalkones by means of selenium dioxide and by alkaline hydrogen peroxide gave 6:8 dichloro flavonols respectively. Incidentally, the chalkones from 3:5-dichloro-2-methoxy-acetophenone with 2-and 4-methoxy and 3:4-dimethoxy-benzaldehydes were also prepared.

211. Oxidation of Thiocarbanilide by Bromine.

R. H. SAHASRABUDHEY and K. S. SURESH, Banaras.

Oxidation of thiocarbanilide (15 g) carried out in an alcoholic medium with bromine under the conditions described by Hugershoff (*Ber.*, 1903, *36*, 3121) gave a pale yellow solution. On standing it deposited (6 g) lemon yellow cubes m.p. 155-156°C. These are probably of the 'monosulphide' PhNH(PhN :)C.S.C.(:NPh) NHPh. The product is very sensitive to reagents and is decomposed in contact with water, alcohol or ammonia into phenyl mustard oil and triphenylguanidine. In presence of dilute acids it gives thiocarbanilide and carbanilide and when maintained for a few minutes at its melting point it gave phenyl mustard oil, carbanilide, and triphenylguanidine.

Further oxidation of the 'monosulphide' in dry chloroform with bromine gave an orange-yellow product, reminiscent of the perbromides of Hunter *et al*, which decomposed on treatment with sulphur dioxide followed by ammonia into the 3 :5-diphenylimino-2-4 :-diphenyl-1 :2 :4-thiodiazole. Thus it would appear that the 'monosulphide' isolated now for the first time is an intermediate product in the oxidation of thiocarbanilide into the supposed thiodiazole. Further work is in progress on the mechanism of the above changes and the constitution of the 'thiodiazoles'.

212. Interaction of Sulphuryl Chloride, Sulphur Monochloride, p-Toluene sulphonyl chloride and benzene sulphonyl chloride with Phenyl-, o-Tolyl-and p-Tolyl-Thioureas.

R. H. SAHASRABUDHEY, K. S. SURESH and
Miss PRANATI MUKHERJEE, Banaras.

Derivatives of 2-aminobenzthiazole are known to be formed by the interaction of sulphur monochloride and thionyl chloride on N- substituted aromatic thiocarbamides (Sahasrabudhey, *J. Ind. Chem. Soc.*, 1944, *21*, 17; 1945, *22*, 37; Allen and Allen, *'Organic Syntheses'*, 1942, *22*, 16). Fromm and Heyer (*Ber.*, 1909, *42*, 3804) have reported formation of a thiodiazole by the action of p-toluene sulphonyl chloride in alcohol on phenyl thiourea. It has been now found that in the case of sulphuryl chloride and sulphur monochloride, phenyl-, o-tolyl- and p-tolyl- thiocarbamides give 2-amino-benzthiazole, 2-amino-4-methyl benzthiazole and 2-amino-6-methyl benzthiazole respectively. p-Toluene sulphonyl chloride and benzene sulphonyl chloride, on the other hand, give corresponding 2 :4-diaryl-3 :5-diimino-1 :2 :4 thiodiazole derivatives. Acetyl-, benzoyl- and picrate derivatives of these various compounds have been prepared.

Thus it would appear that oxidation of aromatic thiocarbamides, irrespective of the nature of the medium (which is benzene in all the above cases, *cf.* earlier work) proceeds along two different routes. With acid chlorides of inorganic sulphur acids and organic sulphonic acids benzthiazoles and thiodiazoles respectively are produced.

213. Oxidation of NN'-Diaryl Thiocarbamides.

R. H. SAHASRABUDHEY and K. S. SURESH, Banaras.

Oxidation of N-aryl- and NN'-diaryl-thiocarbamides in a dilute alcoholic medium is believed to result in the formation of thiodiazoles (Hector, *Ber.*, 1889, *22*, 1177; Hugershoff, *Ber.*, 1903, *36*, 3121). De and Chakravarty (*J. Ind. Chem. Soc.*, 1928, *5*, 662) reported a few 2 :5-diarylimino-3 :4-diaryl-1 :3 :4-thiodiazoles by the hydrogen peroxide oxidation of certain NN'-diaryl thiocarbamides. A reinvestigation of this work of these authors has shown that their products are sulphur free. The supposed thiodiazoles from NN'-diphenyl-, NN'-di-o-tolyl- and NN'-di-p-tolyl-thiocarbamides, reported to melt at 228°-230°C, 249°C and 260°C respectively have now been found identical with the corresponding ureas *viz.*, carbanilide, di-o-tolyl urea and di-p-tolyl urea which melt at 237°, 250° and 263° respectively. Melting points of the mixtures of the above oxidation products and authentic samples of the appropriate urea showed no depression.

214. The Disulphide Oxidation Products of Penyl Thiocarbamide.

R. H. SAHASRABUDHEY and C. N. V. NAMBURY, Banaras.

As with thiocarbamide and its alkyl homologues, disulphides of the type, [RNH(HN :).C.S.S.C.(: NH)HNR] 2 HX, have often been postulated as the primary oxidation products of aromatic thiocarbamides. Fischter and Braun, (*Ber.*, 1914, *47*, 1526) reported the formation of phenyl formamidine disulphide dihydrochloride by the electrolytic oxidation of phenyl thiourea. Analysis or the properties have not been reported excepting that it decomposes into free acid, phenyl thiourea and phenyl cyanamide. It has now been found that the above 'formamidine disulphide' is obtained by the action of thionyl chloride on phenyl thiourea in dry chloroform. It is not possible to purify the compound by the usual methods, but the dry-chloroform washed crude product melts at 108-109°C. Determinations of nitrogen, sulphur, chlorine and equivalent weight (Found 188·6; calculated 187·5) are in good agreement with those expected for phenyl formamidine disulphide dihydrochloride. Depending on the conditions it decomposes into a variety of products *viz.*, phenyl thiourea, Hector's base, 2-aminobenzthiazole, HCl etc. Work is in progress on the mechanism of its decomposition and conversion into the above mentioned thiazole and thiodiazole.

215. Studies in fravanoids—II Synthesis of 2-furyl-3-hydroxy-6-methyl-chromone autoxidations.

K. G. MARATHE, Nagpur and Poona.

In continuation of the previous work on synthesis of flavonols by autoxidation (K. G. Marathe, Science & Culture, 22, 175 (1956) the synthesis of 2-furyl-3-hydroxy-6-methyl-chromone has been carried out. On keeping an alcoholic alkaline solution of 2-hydroxy-5-methyl-acetophenone and furfural in equimolecular quantities with free access of air for two months a substance m.p. 220° was obtained. It was found to be identical with that obtained by hydrogen peroxide oxidation of the corresponding 2-hydroxy-5-methyl-furylidene acetophenone, m.p. 59° prepared by the daisen schmidt condensation of 2-hydroxy-5-methyl-acetophenone and furfural in the presence of alcoholic potassium hydroxide.

216. 3-Chloro-4-methoxyphenyl-n-alkyl sulphides and sulphones.

C. P. HARTMAN, P. B. SATTUR and K. S. NARGUND, Dharwar.

Suter and Hansen [Jour. Am. Chem. Soc., *54*, 4100 (1932)] synthesised a series of p-hydroxyphenyl-n-alkyl sulphides and reported that the germicidal properties are at maximum with n-butyl and n-amyl compounds. So the present work was undertaken to synthesise 3-chloro-4-methoxyphenyl-n-alkyl sulphides and sulphones with a view to see the effect of chlorine on the above type of compounds.

3-Chloro-4-methoxy thiophenol has been condensed with n-alkyl halides from (methyl-to n-hexyl) benzyl chloride, p-chlorobenzyl bromide and with p-iodonitrobenzene. In presence of sodium ethoxide to obtain the corresponding sulphides and these have been further oxidised to the corresponding sulphones by hydrogen peroxide in glacial acetic acid.

217. 2-Chloro-4-methoxyphenyl-n-alkyl sulphides and sulphones.

S. P. ACHARYA, P. B. SATTUR and K. S. NARGUND, Dharwar.

2-Chloro-4-methoxy thiophenol has been condensed with n-alkyl iodides from CH_3 to C_6H_5) benzyl chloride, p-chlorobenzylbromide in presence of sodium ethoxide to obtain the corresponding sulphides. These sulphides have been oxidised by hydrogen peroxide in glacial acetic acid to obtain corresponding sulphones.

218. Studies in thioxanthones : Dichloro-nitro thioxanthones.

V. B. ANGADI, P. B. SATTUR and K. S. NARGUND, Dharwar.

2 :5, 3 :4 and 2 :4 dichloro thiophenols were condensed with 2-chloro-5-nitro benzoic acid to obtain

(i) 2 :5 Dichlorophenyl mercapto-5-nitrobenzoic acid. Crystallised from dilute acetic acid in plates m.p. 252°.
  Ethyl ester. Crystallised from dil. alcohol in straw coloured needles. m.p. 107°.
  Amide Crystallised from dil. alcohol in yellow needles. m.p.205°.

(ii) 3 :4 Dichlorophenyl mercapto-5-nitro benzoic acid. Crystallised from dil. alcohol in colourless granules. m.p. 248°.
  Ethyl ester : Crystallised from dil. alcohol in shining needles. m.p. 110°.
  Methyl ester : Crystallised from dil. alcohol in colourless needles. m.p. 108°.
  Amide : Crystallised from dil. alcohol in needles. m.p. 195°.

(iii) 2 :4 Dichlorophenyl mercapto-5-nitro benzoic acid. Crystallised from dil. acetic acid in colourless granules. m.p. 210°.
  Methyl ester : Crystallised from dil. alcohol in needles. m.p. 167°.
  Ethyl ester : Crystallised from dil. alcohol in colourless needles. m.p. 123-4°.
  Amide : Crystallised from dil. alcohol in short needles. m.p. 180°.

The above acids were cyclised by sulphuric acid to obtain the following dichloronitro thioxanthones.

(i) 1 :4 Dichloro-7-nitro thioxanthone. Crystallised from dil. acetic acid. m.p. 291°.

(ii) 1 :2 Dichloro-7-nitro thioxanthone : Crystallised from dil. acetic acid, in colourless particles. m.p. 287°.

(iii)) 2 :4 Dichloro-7-nitro thioxanthone : Crystallised from dil. acetic acid in particles m.p. 268-70°.

219. α-Aryl fatty acids.

F. V. PATIL, P. B. SATTUR and K. S. NARGUND, Dharwar.

Adams and coworkers [Jour. Am. Chem. Soc., *49*, 2934 (1927)] synthesised a number of α-α-disubstituted acetic acids and found them to be effective against B-laprae. The present work is similar to it. It deals with the preparation of α-benzyl and α-p-chlorobenzyl fatty acids by standard methods.

The following acids have been prepared.

α-Benzyl Heptoic acid b p. 180°/15 mm. Colourless liquid. Ethyl ester b.p. 110°/5 mm. Colourless liquid. Amide m.p. 113°. Colourless shining needles (dil. alcohol).

α-benzyl Caprylic acid b.p. 200°/15 mm. Ethyl ester. b.p. 140°/15 mm. Colourless liquid. Amide m.p. 83°. Colourless needles (dil. alcohol).

α-Benzyl Pelargonic acid b.p. 180°/5 mm. Colourless liquid. Ethyl ester b.p. 90°/5 mm. Amide m.p. 90° shining needles (dil. alcohol).

α-Benzyl Capric acid b.p. 200°/10 mm. Colourless liquid. Ethyl ester 140°/10 mm. Colourless liquid. Amide m.p. 93° shining needles (dil. alcohol).

α-p-chlorobenzyl Heptoic acid b.p. 160°/15 mm. Colourless liquid. Ethyl ester 110°/10 mm. Colourless liquid.

α-p-chlorobenzyl Caprylic acid. b.p. 180°/5 mm. Colourless liquid. Ethyl ester b.p. 120°/10 mm. Colourless liquid.

α-p-chlorobenzyl Pelargonic acid b.p. 200°/15 mm. Colourless liquid. Ethyl ester b.p. 160°/5 mm. Colourless liquid.

α-p-chlorobenzyl Capric acid b.p. 210°/5 mm. Colourless liquid. Ethyl ester 180°/5 mm. Colourless liquid.

220. Synthesis of 3-methoxyl-4-methyl phenyl acetic acid and β-(3-methoxy-4-methyl phenyl) propionic acid.

P. V. PANCHANGAM, P. B. SATTUR and K. S. NARGUND, Dharwar.

In connection with the work on methyl analogue of papaverine, which is in progress in this laboratory, the compounds mentioned in the title have been prepared by Willgerodt's reaction on 3-methoxy-4-methyl acetophenone and 3-methoxy-4-methyl propiophenone. The following are described.

3-Methoxy-4-methyl phenyl acetic acid. m.p. 72°. Colourless plates from dilute alcohol. S-benzyl isothiuronium salt m.p. 149°. Colourless needles, from dilute alcohol.

3-Hydroxy-4-methyl propiophenone. m.p. 111°. Colourless light tan needles from dilute alcohol. Benzoyl derivative. m.p. 101°. On methylation gave the 3-methoxy-4-methyl propiophenone. b.p. 147°/12 mm. Pale yellow liquid. Semicarbazone. m.p. 184°. Colourless shining needles from dilute alcohol. 3-Methoxy-4-methyl propiophenone was subjected to Kindler's modification of Willgerodt reaction to yield β-(3-methoxy-4-methyl phenyl) propionic acid. m.p. 68°. Colourless plates from dilute alcohol. S-benzyl isothiuronium salt m.p. 128°. Colourless needles from dilute alcohol. Ethyl ester b.p. 140-3°/15 mm. pale yellow liquid. Amide m.p. 128-9°. Colourless needles from benzene.

221. Condensation of chloroanisoles with maleic anhydride.

H. G. ABDUL SATTAR, P. B. SATTUR and K. S. NARGUND, Dharwar.

Ortho, meta and para chloroanisoles have been condensed with maleic anhydride in presence of anhydrous aluminium chloride using different solvents like nitro benzene, carbon disulphide and tetrachloro ethane.

o-Chloroanisole and maleic anhydride gave β-3-chloro 4-methoxy benzoyl acrylic acid m.p. 180° colourless needles. (dil. alcohol). Ethyl ester m.p. 55° colourless shining plates (alcohol). Methyl ester m.p. 75° colourless needles (methyl alcohol). Semicarbazone m.p. 22° Colourless plates (dil. alcohol).

m-Chloroanisole and maleic anhydride gave β-2-chloro-4-methoxy benzoyl acrylic acid. m.p. 189°. Pale yellow shining needles (alcohol). Ethyl ester b.p. 170°/15 mm. Methyl ester m.p. 65°. Colourless needles. (alcohol).

p-Chloroanisole and maleic anhydride gave β-2-methoxy-5-chloro benzoyl acrylic acid m.p. 146°. Pale yellow shining needles (alcohol). Ethyl ester b.p. 125°/25 mm.; methyl ester m.p. 63°. Pale yellow needles. (alcohol).

222. On the Constitution of Mesuol.

D. P. CHAKRABORTY and P. K. BOSE, Calcutta.

Further studies on the structure of mesuol (Dutt, Deb & Bose, J. Indian. Chem. Soc., *17*, 277, 1940) revealed the following: (i) it was homogeneous as indicated by counter current distribution technique; (ii) it could be catalytically hydrogenated to a tetrahydro derivative, $C_{23}H_{26}O_{5}$, m.p. 181°C.; (iii) it does not contain a CO group; (vi) the ultraviolet absorption spectra of mesuol suggest the presence of two independent chromophoric groups; (v) the infrared spectra of mesuol and of tetrahydro mesuol show bands characteristic of the following groups—(a) hydroxyl, (b) six membered lactone ring, (c) C-methyl and (d) mono-substituted phenyl nucleus.

Acetone, acetophenone and propionic acid were detected in the alkali degradation products of mesuol. Two other compounds (1) m.p. 189°C. yellow and (2) m.p. 236-45°C. colourless were also isolated. These alkali soluble products gave negative ferric reaction.

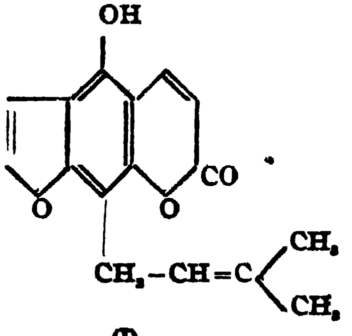
Mesuol is believed to be a complex unsaturated lactone with a dimethyl α-pyran ring system, and a phenyl side chain. The substance has been found to possess some antibiotic properties.

Another compound (m.p. 136°C.) was isolated from the seed kernel of *Mesua ferrea Linn.* (yield ·01%). This compound has also been found to possess some antibiotic properties. Further work is in progress.

223. Synthesis of an isomer of psoralidin methyl ether.

S. K. CHAKRABORTI and P. K. BOSE, Calcutta.

In an attempt to synthesise psoralidin (I), a furano-coumarin derivative isolated from the seed pericarp of *Psoralea corylifolia* L., a compound $C_{17}H_{16}O_{4}$, m.p. 111-13°, having the proposed structure assigned to natural psoralidin methyl ether, has been prepared by a rearrangement of *iso*- imperatorin and methylation. The compound is not identical, but isomeric, with the natural psoralidin methyl ether. Since our product has obviously the linear furano-coumarin structure, it is probable that psoralidin has a structure different from what has been assigned to it by Siddique *et al.* (J. Sc. Ind. Res., 1948, *7B*, 24).



(I)

224. Synthesis of 5-methoxy indole.

SUNIL KUMAR TALAPATRA, SHIBNATH GHOSAL and
ASIMA CHATTERJEE, Calcutta.

A convenient method for the synthesis of 5-methoxyindole has been developed. The starting material employed for this purpose was p-methoxyphenylhydrazine.

It was prepared from p-anisidine according to the method of Altschul (Ber., 25, 1844) with some modifications.

A cold diazotised solution of p-anisidine was immediately treated with an aqueous solution of sodium bisulphite in presence of alkali. Sodium salt of p-methoxydiazobenzene sulphonic acid thus obtained was reduced with zinc-dust and acetic acid to give sodium p-methoxyphenylhydrazine sulphonate. The latter on boiling with hydrochloric acid in alcohol (1 : 7) formed p-methoxyphenylhydrazine hydrochloride. The free base liberated from the hydrochloride was condensed with freshly prepared pyruvic acid in 10% aqueous acetic acid. The separated yellow hydrazone, m.p. 138-39°, was cyclised in absolute alcoholic hydrogen chloride to produce 5-methoxyindole-2-carboxylic acid, m.p. 196-97°. Decarboxylation of this acid at 205-210° (bath temperature) followed by high vacuum distillation afforded 5-methoxy indole, m.p. 55°, in a satisfactory yield.

Attempts to cyclise p-methoxyphenylphenylhydrazone of acetaldehyde in presence of alcoholic hydrochloric acid or anhydrous zinc chloride have failed.

225. Alkyl-Oxygen Fission of 4-Ethoxydiphenylmethanol (p-Ethoxybenzhydrol).

KUMAR THAKER and C. J. SHAH, Vallabh Vidyanagar (Anand).

The carboxylic esters of many secondary alcohols have been shown to undergo hydrolysis by Alkyl-Oxygen Fission. This behaviour is most strikingly exhibited by diphenylmethanols which contain one or more Methoxyl groups substituted in the aromatic nucleui of the molecule.

It was therefore considered of interest to examine the reactions of 4-Ethoxydiphenylmethanol. The results show that the Ethoxyl group possesses a somewhat greater influence than the Methoxyl group.

226. The Optical Stability of 1:2:3:4-Tetrahydro-2-Naphthol.

KUMAR THAKER and (Miss) SARLA PATEL, Vallabh Vidyanagar (Anand).

1 :2 :3 :4-Tetrahydro-2-Naphthylamine was resolved by Pope and Harvey and has shown to undergo extreme racemisation when its salts are decomposed by alkali. This remarkable result has been revised by Davies, Edwin and J. Kenyon.

In an attempt to throw light on this unexpected behaviour, the structurally related 1 :2 :3 :4-Tetrahydro-2-Naphthol has been resolved and examined. In marked contrast to this the lability of the amine, the alcohol and its esters exhibited great optical stability.

227. Potential Antispasmodics. Part II—Quinolyl Thiazoles.

BHASKAR DAS and M. K. ROUT, Cuttack.

Some quinolyl thiazoles likely to possess spasmolytic action have been prepared by fusion of 2-aryl-imino-4-thiazolidones and anthranilic acid in presence of anhydrous sodium acetate.

228. Protographic Sensitisers. Part II. Merodicarbo and Merotricarbo Cyanines.

BIRENDRA K. PATNAIK and M. K. ROUT, Cuttack.

In the present investigation, five merodicarbo- and five merotricarbo cyanines have been prepared from 2-methyl-4-phenyl, 4-p-methoxyphenyl, 4-p-ethoxyphenyl, 4-p-bromophenyl and benzothiazoles. The methiodides of the above thiazoles were first condensed with either β-anilino-acrolein anil hydrochloride or glutaconic aldehyde dianilide hydrochloride. The resulting products were subsequently condensed with 3-ethyl rhodanines. These were prepared for use as photographic sensitisers and also to examine the difference in λ maximum between successive vinylene homologs.

229. Merocyanines derived from Benzimidazole.

PRABHAT KUMAR MISRA, BIRENDRA K. PATNAIK and M. K. ROUT,
Cuttack.

In the present investigation, some merocarbo-, merodicarbo- and merotricarbo cyanines have been prepared from 2-methyl benzimidazole. The methiodide of the latter was condensed with diphenyl formamidine, β-anilino acrole in anil hydrochloride or glutaconic aldehyde dianilide hydrochloride and the resulting products were subsequently condensed with different 2-arylimino-3-aryl-4-thiazolidones. These were prepared to study the sensitising properties of the resulting merocyanines and also to determine the shift in the λ maximum between each successive vinylene homologs.

330. Heterocyclic Steroids : Part IV.—Synthesis of a Furanosteroid.

G. V. BHIDE, N. L. TIKOTKAR and B. D. TILAK, Bombay.

γ-2 :4-Dihydroxybenzoylbutyric acid (I) on methylation gave methyl γ-2-hydroxy-4-methoxybenzoylbutyrate (II) which, on treatment with ethyl bromoacetate, potassium carbonate in methyl ethyl ketone and subsequent hydrolysis furnished γ-2-carboxymethoxy-4-methoxy-benzoylbutyric acid (III). The latter was refluxed with acetic anhydride and sodium acetate when 3-ω-carboxypropyl-6-methoxybenzofuran (IV) was obtained along with a very small quantity of 7-methoxy-4-oxo-1 :2 :3 :4-tetrahydrodibenzofuran (V). (V) was also obtained from (IV) by refluxing the latter with acetic anhydride and acetic acid containing zinc chloride.

Compound (V) was then converted to 15-carbethoxy-14 :15-dehydro-B-*nor*-6-oxa-equilenin methyl ether (VI) in four steps by Johnson *et. al's* procedure (J.A.C.S., 1947, *69*, 2942).

Conversion of (VI) to the furano analogue of equilenin is in progress.

231. "Heterocyclic Steroids : Part V. Attempted synthesis of pyrrolo-steroids".

G. V. BHIDE, N. L. TIKOTKAR and B. D. TILAK, Bombay.

Synthesis of pyrrolo analogues of equilenin and 3-desoxy-equilenin, wherein the B ring is replaced by the pyrrole ring, was attempted without success. 2-Cyano-2 :9-dimethyl-7-methoxy-1-oxo-1 :2 :3 :4-tetrahydrocarbazole and 2-cyano-2 :9-dimethyl-2 :9-dimethyl-7-methoxy-1-oxo-1 :2 :3 :4-tetrahydrocarbazole were prepared but failed 1-oxo-1 :2 :3 :4-tetrahydrocarbazole) were prepared but failed to undergo the Stobbe condensation with diethyl succinate on account of the inaccessibility of the keto group due to steric hindrance. In order to get around the latter difficulty, 2-cyano-2-methyl-1-oxo-1 :2 :3 :4-tetrahydrocarbazole (I) was synthesised which, however, did not undergo the Stobbe reaction with diethyl succinate due obviously to the enolizability of the keto group in (I).

A third route to the pyrrolo-steroids consists in the cyclization of the Stobbe condensation product, β-carbethoxy-β-(3 :4-dihydro-9-methylcarbazolyl-1)-propionic acid (II) and introduction of the angular methyl group at a later stage. The acid (II) has been synthesised and further work is in progress.

232. Synthesis of some new sulphonphthaleins.

A. B. SEN and S. L. ARORA, Lucknow.

This paper reports the preparation of several sulphonphthaleins derived from 4-methyl, ethyl, propyl and butyl-resorcinols, α-naphthol, hydroquinone and p-cresol. The use of these dyes as indicators are under investigation.

233. Possible Antiamoebic Agents : Part IV. Mannich Bases from Substituted Chromanones.

A. B. SEN and S. L. ARORA, Lucknow.

In continuation of our work on 'Possible anti-amoebic agents', we have now prepared a number of mannich bases from 8-methoxy; 7-methyl-6-chloro-; 8-Iodo-6-chloro-; 8-Iodo- & 6-Iodo chromanones, with a view to study the effect of these groups and their position in the nucleus, on the antiamoebic activity.

Substituted β-phenoxy-propionic acids were prepared by condensing *O*-methoxy-, *m*-methyl-*p*-chloro;; *O*-iodo- *p*-chloro; *O*-iodo- and *p*-iodo phenols respectively, with β-propiolactone. The chromanones were then obtained by the cyclisation of these acids with conc. H_2SO_4 or P_2O_5. The chromanones were then condensed with para-formaldehyde and different amine hydrochlorides in benzene containing a few drops of HCl.

234. Possible Antiamoebic Agents Part V ; Syntheses of some Substituted dialkyl-amino-trimethylene benzylamines.

A. B. SEN and YASHWANT D. KULKARNI, Lucknow.

Several substituted dialkylamino-trimethylene-benzylamines (I) structurally related to emetine and their dichloro-acetates have been synthesized with a view to test them for their anti-amoebic activity.

The benzylamines (I) were obtained by following one of the methods given below :

(*i*) By the condensation of substituted benzyl bromides (4-chloro and 2, 4-dichloro-benzyl bromide) with γ-dialkylaminon-propylamines (II).

(*ii*) By the condensation of equimolar quantities of substituted benzaldehydes (2-chloro, 3, 4-dimethoxy and 2-hydroxy-5-chloro-benzaldehyde) with (II), followed by the catalytic hydrogenation of the schiffs bases in ethyl alcohol over platinum catalyst.

The γ-dialkylamino-n-propylamines (II) γ-piperidino; γ-morpholino; and γ-diethylamino-n-propylamine) were obtained by the condensation of secondary amines (piperidine, morpholine and diethylamine) with acrylonitrile, followed by high pressure (500-550 Lb/sq. inch) hydrogenation of the resulting β-substituted propionitrile in absolute methyl alcohol, saturated with dry ammonia, over Raney-Nickel as catalyst.

Dichloro-acetates of (I) were obtained by the slow addition of ethylene dichloride solution of dichloro-acetyl chloride into vigorously stirred solution of (I) in ethylene-dichloride, in the presence of sodium hydroxide.

235. Studies on 2-α-Naphthylimino-3-α-Naphthyl- and 2-β-Naphthylimino-3-β-Naphthyl-4-Thiazolidones.

P. N. BHARGAVA, Miss UMA BHATNAGAR and G. SATYANARAYANA, Banaras.

2-α-Naphthylimino-3-α-naphthyl- and 2-β-naphthylimino-3-β-naphthyl-4-thiazolidones have been synthesised from the corresponding S-di-α- or β-naphthyl thioureas and monochloroacetic acid and their properties, degradation products as well as characteristic group reactions have been studied.

236. Studies on 3-m-Tolyl-2:4-Thiazolidione and 5-Arylazo-3-Phenyl-2-Phenylimino-4-Thiazolidones.

P. N. BHARGAVA, A. J. PANTULU and R. P. RAO, Banaras.

3-m-Tolyl-1 : 2 : 4-thiazolidione prepared from S-di-m-tolylthiourea and monochloro acetic acid in glacial acetic acid medium has been condensed with six aldehydes and its degradation products as well as characteristic reations have been studied. Further 5-arylazo-3-phenyl-1 : 2-phenylimino-4-thiazolidones have been obtained by condensing 3-phenyl-1 : 2-phenylimino-4-thiazolidone with aryl diazonium chlorides.

237. Studies on the Kinetics of Chlorination of carboxylic acids by thionyl chloride. Part I. Reaction between propionic acid and thionyl chloride.

ZAFAR NAIM and M. O. FAROOQ, Aligarh.

The reaction between propionic acid and thionyl chloride was studied at various stages during the progress of the reaction by using the amount of hydrogen chloride evolved as a measure of the rate of the reaction. Experiments were performed at temperatures 15°, 25°, 35°, 45°, and 55°C. by immersing the reaction vessel in a thermostatic water bath with an accuracy of ±0·05°C. The influence of concentration on the rate of the reaction was also observed by using different molecular concentration of the reactions at one particular temperature.

From the observations it has been concluded that the reaction is a bi-molecular one, the value of Qv ranging from 12010-14540 calories per gm. mole between 15-55° C. The reaction is slow in the initial and final stages as shown by the values of K. Only in the middle stages an optimum condition is realised. Although no regular relationship between the concentrations of the reactants and the values of K could be observed, it is however seen that high concentrations help in the progress of the reaction.

238. Ammonolysis of Ethylene Chlorohydrin.

V. A. KRISHNA MURTHY and M. R. A. RAO, Bangalore.

The reaction of ammonia with ethylene chlorohydrin has been investigated with a view to finding out the optimum experimental conditions for the maximum yield of monoethanolamine and also to formulating the thermodynamic constants for the reaction. The effect of experimental variables like temperature, ratio of reactants, and concentration of reactants have been worked out. Nearly 92 per cent conversion of chlorohydrin to ethanolamine has been obtained at 110°C., 200 p.s.i. pressure and at an ammonia to chlorohydrin ratio of about eight.

239. Synthesis of Samin.

D. K. BANERJEE, B. H. IYER and N. L. MURTY, Bangalore.

Synthesis of samin, a degradation product of sesamolin which is one of the pyrethrum synergists in sesame oil, has been achieved.

Diethyl α-vinyl-α'-piperonoyl succinate (IV), prepared by the condensation of ethyl piperonoylacetate with ethyl α-bromovinyl acetate, was reduced with lithium aluminium hydride to 2-vinyl-3-(*ω*-hydroxy-piperonyl)-tetramethylene-1, 4-glycol (V), which on cyclization with alcoholic hydrogen chloride gave 2-(3', 4'-methylenedioxyphenyl)-3-hydroxymethyl-4-vinyl-tetrahydrodrofuran (VI). Ozonolysis of the latter compound led to the formation of dl-samin with the open structure (IIIb).

The fact, that Oppeneur oxidation of VI yielded an aldehyde, proved that the cyclization of V had taken place in the desired fashion.

Experiments towards the synthesis of sesamolin and sesamin from IIIb are in progress.

240. Synthesis of the Lactone of 2-Carboxy-4-hydroxy-6-methoxy-tetralone-1.

D. K. BANERJEE and G. BAGAVANT, Bangalore.

3-Carboxy-7-methoxytetralone-1 was prepared by adopting the procedure of campbell *et. al.* [Campbell, K. N., Cella, J. A., and Campbell, B. K.—*J. Amer. Chem. Soc.*, **75**, 4681, (1953)]. The acid was esterified with diazomethane; and the Meerwein-Ponndorf reduction of the keto-ester yielded the lactone (m.p. 103°) directly, in low yield. Oxidation of the lactone with chromium trioxide in acetic acid solution yielded the lactone of 2-carboxy-4-hydroxy-6-methoxytetralone-1 (m.p. 136°), an important intermediate in a projected synthesis of aldosterone.

241. Polymolecularity of Polyesters of 9:10-dihydroxyhexadecane-1:16 dicarboxylicacid.

PROMODE R. BHATTACHARYA, Namkum.

The weight distribution of different species of polyester molecules with different degrees of polymerisation composed in a particular polyester system was studied. Three self-ester of the above diacid having low, medium and high degree of polymerisation were taken and successive fractionations were continued till quantitatively no fraction further remained in the solution to be precipitated. The precipitations were carried out in acetone solution of polyster using water as nonsolvent at room temperature. Curves were drawn indicating the integral weight distribution of the various fractions thus obtained by plotting the percentage of polyester remaining in solution (G) after a fraction had been separated against its DP, the degree of polymerisation. From this curve, the differential weight distribution curve was drawn again by plotting dG/dDP against DP. Again from the differential weight distribution curve, differential number distribution curves dn/dDP were constituted showing the growth of number of molecules against the DP.

242. A new method for the preparation of Aliphatic Thiourethanes and o-Esters of Alkyl Thiocarbamic. acids.

R. H. SAHASRABUDHEY and C. N. V. NAMBURY, Banaras.

The above compounds have been reported to be formed by the following methods : interaction of (i) alkyl thiocarbamic acidchlorides with sodium alcoholates

(Billeter, *Ber.*, 1910, **43**, 1856); (ii) O, O-diesters of monothiocarbonic acid or S-alkyl esters of xanthic acid with alkyl amines (Delepine, *Bull. Soc. Chim.*, 1910, [4] **7**, 899; *Comp. rend.*, **150**, 876; Billeter, *loc. cit.*); (iii) mustard oils and alcohol (Hoffmann, *Ber.*, 1869, **2**, 117) and (iv) sodium alcoholate with thiuram sulphides (Delepine, *Bull. Soc. Chim.*, 1910, [4] **7**, 409). The starting materials in all these cases are themselves derivatives of thiocarbamic-, xanthic-, monothiocarbonic-, or dithiocarbonic acids, not always easily obtained.

It has now been found that the above compounds can be prepared with ease in good yields by the direct interaction of potassium ethyl xanthate with alkyl amines in aqueous medium at ordinary temperature. The products which are water-insoluble liquids or low melting solids can be separated by the usual methods. By the interaction of appropriate alkyl amine and potassium alkyl xanthate following compounds have been prepared in yields 75-85% : O-methylester of dimethyl thiocarbamic acid, b.p. 190-191°C; O-isobutylester of dimethyl thiocarbamic acid, b.p. 228-230°C; dimethyl thiourethane, b.p. 203°C and ethyl thiourethane, b.p. 205-208°C (42%).

243. Interaction of Aromatic Dithiocarbamates with Aromatic Amines.

R. H. SAHASRABUDHEY and C. N. V. NAMBURY, Banaras.

The role of dithiocarbamates in the synthesis of disubstituted arylthioureas is well known (J. *v.* Braun and Beschke, *Ber.*, 1906, **39**, 4369-78; Losanitsch, *Ber.*, 1882, **15**, 470). Since dithiocarbamates are nearly exclusively formed by the interaction of carbon disulphide, amine and alcoholic potash, it was thought likely that they would result by the interaction of potassium ethyl xanthate and amines at higher temperatures (140° and 180°C), under which conditions s-di-thiocarbamides are also known to be produced. The reaction between dithiocarbamates and aromatic amines was therefore investigated. By heating aniline with ammonium phenyl dithiocarbamate at 180° and 140°C for one hour, at 90-95°C for two hours or at 30°C for 48 hours, only 10-20% thiocarbanilide were obtained. o-toluidine and ammonium o-tolyl dithiocarbamate when treated similarly gave 10-15% of s-do-o-tolyl thiourea and p-toluidine and ammonium p-tolyl dithiocarbamate 36-52% of di-p-tolyl thiourea. Even when ammonium phenyl dithiocarbamate was heated alone under the above conditions about 7% thiocarbanilide was obtained. The poor yields of thioureas obtained in these experiments suggest that dithiocarbamates behave differently at 140° and 180°C and in alcoholic solutions.

244. A new method of preparing symmetrical Diaryl Thiocarbamides.

R. H. SAHASRABUDHEY, C. N. V. NAMBURY and
Miss BHRAMARAMBA, Banaras.

Aromatic primary amines have been found to react with potassium ethyl xanthate to give s-diaryl thiocarbamides as the principal products. The reaction was investigated with respect to a number of amines under a variety of conditions. For example by heating potassium ethyl xanthate with a moderate excess of aniline, o- and p-toluidines, α- and β-naphthylamines, o- and p-phenetedines and benzylamine either at 140° or 180°C for two hours, thiocarbanilide (50%), s-di-o-tolyl thiourea (43%), s-di-p-tolyl thiourea (57%), s-di-α-naphthyl thiourea (66%), s-di-β-naphthyl thiourea (67%), s-di-o-phenetyl thiourea (44%), s-di-p-phenetyl thiourea (59%) and s-di-benzyl thiourea (98%) respectively were obtained. The reaction was also found to take place with o- and p-chloroanilines, p-bromoaniline and o-anisidine, but the yields were comparatively poor in these cases (5-25%).

The reaction was found to be very slow at lower temperatures or in presence of a solvent like alcohol or alcoholic potash. Further work is in progress.

245. Modification of alkyd apparatus.

N. BHOJRAJ NAIDU, Hyderabad-Deccan.

Our previous work regarding the improvements effected, on the setting-up of alkyd apparatus still showed some few defects such as difficulty in adding phthalic anhydride and catalyst and continually maintaining the azeotropic solvent under operating temperatures in the reaction mixture. In the apparatus now set up, provision has been made for the addition of phthalic anhydride and catalyst, withdrawal of samples measurement of temperature and the Dean-Stark type for the recovery of water of reaction in the presence of azeotropic solvent xylol, thereby eliminating the afforesaid defects.

246. The near ultraviolet absorption spectrum of 3 Bromo Thianaphthene Vapour.

M. R. PADHYE and R. P. PUNYARTHI, Bombay.

The near ultraviolet spectrum of 3 Bromo thianaphthene vapour has been photographed. The complete spectrum of this compound consists of two regions of absorption analogous to those in thianaphthene. The longest wavelength region between 2970 and 2750Å consists of large number of sharp deserete bands degraded to the red. Over 40 bands belonging to this system have been measured and analysed in terms of the vibronic transitions involved. The analysis is compared with that in case of thianaphthene for an analogus transition.

247. Chromatographic examination of sugars in some wild fruits of Naini Tal—I.

S. C. GUPTA and D. R. GUPTA, Naini Tal.

With the help of descending paper chromatography, using n-butanol-acetic acid-water (4 :1 :5) as solvent phase and benzidine reagent (0·5 gm. benzidine, 10 ml. acetic acid, 10 ml. 45% trichloroacetic acid, and 100 ml. 95% ethanol) for the detection of spots, six local wild fruits of Naini Tal area were examined for sugars.

Sucrose, glucose and fructose were found to be present in the fruits of *Solanum capsicastrum* (wild chilli) and *Rosa* sp. (cultivated); maltose, glucose and fructose in the fruits of *Vibernum cotinifolium* Don. ("Ghenu"); glucose and fructose in the fruits of *Punica granatum* L. ("Dharim", local sour variety) and *Lantana camara* L. ("Kuri"); and very small quantity of glucose in the fruits of *Nicandra physaloides* Gaertn.

R_f values of eight sugars were also estimated.

248. Chromatographic examination of acids in some wild fruits of Naini Tal—I.

D. R. GUPTA and S. C. GUPTA, Naini Tal.

Some wild fruits of Naini Tal found during July-September have been examined for different acids by descending paper chromatography.

Butanol-formic acid-water (10 :2 :5) and butanol-acetic acid-water (4 :1 :4) were used as solvent phases, the former being more satisfactory. Bromo-phenol-blue (80 mg./100 ml. 95% ethanol) was used as spray reagent for detection of spots.

The R_f values using butanol-formic acid-water solvent, for oxalic, tartaric, ascorbic, citric, malic and succinic acids were found to be 0·2, 0·25, 0·33, 0·36, 0·43 and 0·76 respectively.

Nicandra physaloides Gaertn. and *Punica granatum* L. ("Dharim", local sour variety) were found to contain only citric acid, while *Solanum capsicastrum* (wild chilli) had malic acid only. Chromatographically no acid was detected in the fruits of *Vibernum cotinifolium* Don. ("Ghenu"), *Rosa* sp. (cultivated) and *Lantana camara* L. ("Kuri").

249. End-group determination of glucose residues per non-aldehydic terminal group in starches by Sodium Meta per-iodate oxidation.

R. D. PATEL and R. S. PATEL, Vallabh-Vidyanagar (Anand).

Chain length of glucose residues per non-aldehydic terminal group in starch has been determined by the oxidation of starches with sodium meta per-iodate at temperature 13° to 14°C. The values of glucose residues per non-aldehydic terminal group in different starches are as follows :—Bajari—26·05, Wheat—28·03, Kodari—28 81, Bavato—30·14, Wal—30·56, Moriyo—31·16, Math—31·79, Vatana—31·79, Jowar—33 31, Mag—33·79, Chana—33·9, Chola—34·3, Lang—36·47, Rice—41·57.

250. Fractionation of Starches into Amylose and Amylopectin by Thymol method.

R. D. PATEL and R. S. PATEL, Vallabh-Vidyanagar (Anand).

Fractionation of starches was not possible by the method described by Schoch. The purity of the factions obtained the Schoch's autoclaving method was very low. Hence that method was not followed. In the present investigation the fractionation of the starches was carried out by the thymol method. The following properties of the fractions were studied. (I) Iodine affinity, (II) Viscosity in KOH and (III) Chain length of glucose residues in the non-aldehydic terminal group.

251. Chemotherapeutic Dyes. Part III. Synthesis of substituted aminophenothiazines.

A. B. SEN and R. C. SHARMA, Lucknow.

Phenothiazine and a number of its derivatives are well known anthelmintics, antihistamines, and antiemetics etc. The therapeutic activity of these phenothiazines has been attributed to their ready oxidation to 3-quinone. A number of 1 or 3 aminophenothiazines containing alkyl phenyl or ester groupings have, therefore, been synthesised with a view to test them for their therapeutic activity.

For this purpose eight diphenyl sulphides viz. 2′-amino 6-carbmethoxy 2 :4 dinitro, 2′-amino 6-carbethoxy 2 :4 dinitro, 2′-amino 4-carbethoxy 2 :6 dinitro, 2′-amino 5-ethyl 2 :4 dinitro, 2′-amino 6-phenyl 2 :4 dinitro, 2′-amino 6-methyl 2 :4 dinitro, 2′-amino 5-methyl 2 :4 dinitro and 2′-amino 4-(p-nitrophenyl) 2 :6 dinitro, were synthesized by the condensation of o-aminothiophenol with appropriate dinitro chloro compounds. They were subjected to 'Smiles Rearrangement' for the preparation of nitrophenothiazines which were subsequently reduced catalytically to amino-phenothiazines.

252. Synthesis of some Chemotherapeutic Sulphones.

A. B. SEN and A. K. ROY, Lucknow.

Some substituted phenyl benzyl sulphones have been prepared with a view to test them for their insecticidal and fungicidal properties.

The sulphones were obtained by the oxidation of the corresponding sulphides with 30% hydrogen peroxide in glacial acetic acid. The sulphides were prepared by the condensation of the thio-phenols with various benzyl halides in dry acetone in the presence of fused potassium carbonate.

The following are described :—

1. o-chlorophenyl p-nitrobenzyl sulphide M.P. 79: Sulphone M.P. 156.
2. p-chlorophenyl p-nitrobenzyl sulphide M.P. 55: Sulphone M.P. 167.
3. p-methoxyphenyl p-nitrobenzylsulphide b.p. 178/22 mm: Sulphone M.P. 140.
4. o-chlorophenyl, 2′ 4′ dichlorobenzylsulphide b.p. 156/22 mm: Sulphone M.P. 96.
5. p-chlorophenyl, 2′ 4′ dichlorobenzyl sulphide b.p. 173/22 mm: Sulphone M.P. 105.
6. 2, 4 dichlorophenyl p-nitrobenzylsulphide M.P. 155: Sulphone M.P. 116 (dec.).
7. p-methoxy phenyl 2′ 4′ dichlorobenzyl sulphide b.p. 168/22 mm: Sulphone M. P. 97.
8. p-methoxyphenyl p-chlorobenzylsulphide b.p. 173/35 mm: Sulphone M. P. 168.
9. p-chlorophenyl p-chlorobenzylsulphide M.P. 72: Sulphone M.P. 147.

253. Synthesis of Cyanine dyes by the Condensation of p-Diethylamine benzaldehyde with appropriate Heterocytic Compounds.

M. Q. DOJA and J. C. BANERJEE, Patna.

Four new dyes have been prepared by condensing p-diethylamino-benzaldehyde with the methiodides of 2:4-dimethyl-, 2:5-dimethyl- 2:7-dimethyl- and 2-methyl-6-iodo-benzthiazole and their optical and other properties examined.

254. Studies on Indigoid Dyes: Part III.

ARUN KUMAR SINHA, Patna.

Three new dyes have been synthesised by condensing 5-iodothioindoxyl with 3-chloroacenaphthenequinone, β-methoxyacenaphthenequinone, 5-iodoisatin and a fourth by the condensation of 4-chlorothioindoxyl with 5-iodoisatin. The dyeing properties of the compounds have been studied and their absorption maxima recorded.

255. Dyes derived from Naphthalic and Cis-cyclohexene 1,2-di carboxylic anhydride.

A. B. SEN and S. L. ARORA, Lucknow.

A number of phthalein type of dyes have been prepared from the above two acid anhydrides and resorcinol and alkyl resorcinols viz., methyl, ethyl and propyl, with a view to test their sensitivity as indicators.

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256. Di-iso-amyl rubeanic acid as a colorimetric reagent.

J. XAVIER and PRIYADARANJAN RAY, Calcutta.

The *N*-*N*-di-isoamyl derivative of rubeanic acid was found to behave almost similar to its other alkyl analogues, giving coloured precipitates with copper, cobalt, nickel, palladium, etc. It was, however, noticed that the retardation in colour development with metallic ions by an alkaline solution of the reagent was more pronounced than in the case of diethyl or di-*p*-hydroxyethyl rubeanic acid. The following identification and concentration limits were obtained, under conditious similar to those maintained as with other substituted rubeanic acids :

Cu, 0·05 γ ($1:8\times10^6$); CO, 0·03 γ ($1:1{\cdot}3\times10^6$);
Ni, 0·02 γ ($1:2\times10^6$) and Pd, 0·1 γ ($1:3\times10^5$).

Methods for the spectrophotometric determinations of cobalt, nickel and palladium have been developed as in the case of its di-β-hydroxyethyl analogue. The orange-yellow colour due to cobalt (pH 10·2) when measured at 400 mμ gave a sensitivity of 0·0056 γ Co per cm^2 (Sandell). Nickel has been determined at pH 10·3-11·5, by measuring the optical density of the rose-red colour at 510 mμ. Sensitivity : 0·0073 γ Ni per cm.^{2} The yellow colour of palladium complex developed above pH 2·5 gave a sensitivity of 0·011 γ Pd per cm.^{2} The systems in all the cases were found to obey Beer's law. An alcoholic solution of the reagent (1 cc. of 0·1%) was used in all the experiments. 5 cc. of pyridine were generally added for keeping the cobalt and nickel complexes in solution.

Di-iso-amyl rubeanic acid was prepared by warming rubeanic acid with an alcoholic solution of iso-amylamine.

257. Benzo and Salicyl Hydroxamic Acids as Gravimetric Reagents for Titanium and Zirconium.

AMIYA KUMAR CHAKRABURTTY, Jadavpur, Calcutta.

Benzo and salicyl hydroxamic acids, which quantitatively precipitate titanium (IV) and zirconium (IV) respectively as flocculent yellow and white compounds in the pH range 2·5 to 6, have been utilised for the gravimetric estimation of these two elements. The respective compounds, when dried at 110°C and 120°C, have the composition $TiOR_2$ and $ZrOR_2$, R being one molecule of benzo or salicyl hydroxamic acid ion ($C_7H_6O_2N$ or $C_7H_6O_3N$) and can be directly weighed as such.

These elements have been estimated in presence of most of the common cations including $Al^{3}+$, $Be^{2}+$, $Cr^{3}+$, $Cd^{2}+$, $Zn^{2}+$, $Mn^{2}+$, $Co^{2}+$, $Ni^{2}+$, $UO_2{}^{2}+$, $Pd^{2}+$, $Mg^{2}+$, $Ca^{2}+$ and alkali and alkaline earth metal ions, when precipitated in the range 2·5 to 3. Anions like $SO_4{}^{2}-$, NO_3-, $Cl-$, $WO_4{}^{2}-$ etc. do not interfere under similar conditions.

$Cu^{2}+$ and $Fe^{3}+$, which ordinarily interfere, have been effectively masked by thiourea and thioglycollic acid respectively.

But phosphoric, tartaric, citric and oxalic acids and EDTA, vandate, etc. seriously interfere with the estimation.

Zirconium can be estimated in presence of titanium by using lactic acid as a masking agent for the latter element in the pH range 4 to 6. Zirconium has also been estimated in presence of titanium by the addition of sufficient hydrogen peroxide which keeps the latter in solution as pertitanic acid.

258. Some substituted thiourea derivative as precipitants for inorganic cations.

SURESH CHANDRA SRIVASTAVA and ARUN K. DEY, Allahabad.

The following derivatives of thiourea have been prepared by suitable condensation :

(i) *p*-bromo-phenyl-thiourea.
(ii) *p*-ethoxy-phenyl-thiourea.
(iii) *p*-tolyl-thiourea
(iv) *m*-tolyl-thiourea.
(v) *o*-tolyl-thiourea.

(i), (iv) and (v) are soluble in water, while the other two in 80% ethanol. The solutions of these compounds yield precipitates and in a few cases characteristics colour with several metal ions in solution. These compounds, hence, show promise as suitable precipitating or colorimetric reagents in the analysis of inorganic cations, for which details are being worked out.

259. 2:4-Hydroxy-5-Chloro-Acetophenone as a Reagent in Inorganic Analysis.

SAMIR K. BANERJI and ARUN K. DEY, Allahabad.

The compound 2:4 hydroxy-5-chloro-acetophenone has been found to be a sensitive colorimetric reagent for iron (III) and uranyl (II) ions. The colour of the iron chelate is black, while uranyl ions produce a characteristic brown yellow colour in the neutral medium. The reagent is to be used in a 0 1 per cent alcoholic solution, which is itself of a pale yellow colour.

260. The use of Dithio-oxamide as a Colorimetric Reagent in the Detection on Metal ions.

SAMIR K. BANERJI and ARUN K. DEY, Allahabad.

Dithio-oximide (Rubeanic acid) has found application in the detection of nickel, cobalt and copper ions. In the present paper we have reported that the reagent also forms coloured chelates with potassium dichromate and with zirconium salt, and hence suggested the use of this reagent in the detection of these ions.

261. p-Dimethylamino-Benzal-Rhodanine as a Colometric Reagent in Inorganic analysis.

SAMIR K. BANERJI and ARUN K. DEY, Allahabad.

The colorimetric reagent *p*-dimethylamino-benzalrhodanine has found application in the detection and determination of silver and the detection of cuprous and mercury ions. In this paper we have noted colour reactions of the reagent with nearly forty metallic elements and have found that the reagent yields coloured complexes with thallium, mercuric, antimony, tin, gold, chromium and iron as well. Further work on the study and use of the reagent is in progress.

262. Pyrogallol as a Reagent for Metal Ions.

LALA SHYAMA PRASAD SINHA, Burdwan.

Pyrogallol has proved fruitful for the detection of group I metals, Mercurous, Lead and Silver; Group II (A & B) metals, Mercuric, Bismuth, Cadmium, Copper, Tin, Arsenic and Antimony, as well as for Ferrous, Ferric, Cobalt, Nickel, Chromium and Manganese. It can be used for the distinction between Mercurous and Mercuric salts and Ferrous and Ferric Salts.

The reagent forms distinctive precipitates with some cations and with others, it forms characteristic colourations.

263. Determination of Cobalt with N-Benzoyl-Phenyl Hydroxyl-Amine.

S. K. SINHA and S. C. SHOME, Calcutta.

N-benzoyl-phenylhydroxylamine has been used for the gravimetric determination of Cobalt. The organic reagent precipitates cobalt quantitatively in acetic acid—acetate medium. The cobalt-complex corresponds to the formula $Co(C_{13}H_{10}O_2N)_2$ and is directly weighable, when the metal is precipitated in the presence of a small amount of hydroxylamine hydrochloride. The reagent has been found useful in the separation of cobalt from copper and in the determination of both cobalt and copper in a mixture of the two metal ions.

264. A new Spectrophotometric Method for Estimation of Cobalt.

JAGDISH SHANKAR and S. B. SRIVASTAVA, Bombay.

The formation of the coloured complex, cobaltic nitro-EDTA, obtained when cobaltous sulphate and solution of a mixture of sodium nitrite and disodium salt of ethylenediamine tetraacetic acid are mixed has been used for the estimation of cobalt using Beckman DU spectrophotometer. It has been found that a mixture of EDTA and sodium nitrite, under suitable conditions, can be used as a better eluting agent for cobalt adsorbed on Amberlite IR-120 then EDTA alone and the cobalt estimated directly in the eluant.

265. Uranyl-Alizarin Blue-S Complex a Spectrophotometric Study.

K. S. VENKATESWARLU, Bombay.

In mixtures of 60% acetone plus 40% water uranyl ions and alizarin blue-S form a purple coloured complex with absorption maximum at 500 mμ. Initially the dye has a maximum at 450 mμ which is shifted to longer wave lengths on complexation. Beer's law is obeyed for the dye as well as the complex in the concentration region 10^{-5} M.

The stoichiometric ratio of the uranyl to the dye is 1 :1 as found by 3 different methods.

266. Colorimetric Estimation of Silicon in Ferro-manganese.

G. V. L. N. MURTY and S. K. MAZUMDAR, Jamshedpur.

Attempts to extend the fairly well-established procedure for the colorimetric estimation of silicon in pig iron and steel to ferro-manganese samples also showed that it is necessary to (*i*) modify the composition of the solvent-mixture (*ii*) prolong the heating time and (*iii*) exercise a more rigid control on the particle size. The finalised procedure for rapid and accurate determination of silicon in ferro-manganese is described and a comparative statement of results obtained by different methods presented.

267. Separation of Niobium and Tantalum with Cupferron.

A. K. MAJUMDAR and J. B. RAY CHOWDHURY, Jadavpur, Calcutta.

An attempt at the separation of niobium and tantalum by cupferron shows that at a pH between 4·5 and 5·5 niobium is completely precipitated while tantalum remains in solution, when the ratio of Nb :Ta is 1 :2. Higher amounts of tantalum tend to keep the niobium in solution. Limited success is achieved, however, with magnesia mixture as a coagulating agent. But most satisfactory separation of niobium and tantalum from each other, attempted up to the ratios of 30 :1 and 1 :30 is effected with Sn^{+3} or Sn^{+4} as a co-precipitating agent and under the condition niobium can be separated in presence of complexone III from almost all the ions except U, Be, Ti and Po_4^{-3}. Iron and other tervalent elements when present in 100 fold excess to niobium require double precipitation. The method gives highly satisfactory results when applied to the analysis of niobium of niobium-molybdenum stainless steel.

Titanium can also be used as a coprecipitant like tin and the former when present helps the complete precipitation of niobium and to a much less extent of tantalum. Complete precipitation of niobium with titanium is possible only when the amount of tantalum is not more than three times the amount of niobium.

268. Colorimetric determination of Bivalent Copper using Sodium Alizarin-3-Sulphonate as a Reagent.

ANIL K. MUKHERJI and ARUN K. DEY, Allahabad.

The formation of an 1 :1 copper chelate with sodium alizarin-3-sulphonate, having λ max at 500 mμ has been described. The colour formation has been applied to the colorimetric determination of copper II on a micro-scale. The colour has been found to be stable between pH 3·20 to 7·50, at temperatures 20°—30°C. The sensitivity of the reagent is 6·4 p.p.m. of copper. The interference by a large number of cations and anions has been studied spectrophotometrically and the tolerance limits determined. It has been recommended that reagent is suitable for the colorimetric determination of copper and the conditions have been prescribed.

269. Aluminon as a Colorimetric Reagent for Inorganic Cations. : Part I. Micro-Determination of Copper II.

ANIL K. MUKHERJI and ARUN K. DEY, Allahabad.

The formation of a coloured chelate between cupric ion and ammonium aurintricarboxylate (Aluminon) has been taken advantage of, in the colorimetric determination of small amounts of bivalent copper. It has been found that for satisfactory results, at least twenty-fold molar excess of the reagent must be added. The intensity of colour may be measured with the help of a spectro-photometer or with a photoelectric colorimeter.

The colour is stable at room temperature, but the intensity of colour decreases above 30°C. For the formation of a colour suitable for measurement, the pH should be within 5·3—6·7. The smallest amount of copper that can be detected by the reagent is 1·7 p.p.m. Details have been worked out for the use of the reagent and the interference by various foreign ions has been noted and the tolerance limits determined spectrophotometrically.

270. Aluminon as a Colorimetric Reagent for Inorganic Cations : Part II. Micro-Determination of Beryllium II.

ANIL K. MUKHERJI and ARUN K. Dey, Allahabad.

Aluminon produces a color with bivalent beryllium salts, the reagent being sensitive to 0·5 p.p.m. of beryllium. Beer's law is obeyed in the range of concentration 0·5 to 100 p.p.m. of beryllium. For the estimation of beryllium using Aluminon, the pure salt is treated with an excess of the reagent, pH adjusted to 6·00 ± 0·20 and the colour intensity measured with a spectrophotometer or a colorimeter. The temperature of observation should be below 30°C, as the colour is not stable above this temperature.

271. Aluminon as a Colorimetric Reagent for Inorganic Cations : Part III. Micro-Determination of Iron III.

ANIL K. MUKHERJI and ARUN K. DEY, Allahabad.

The formation of an 1 :1 chelate between iron III and Aluminon has been reported. The chelate has λ max at 560 mμ. The reagent is sensitive to 1·1 p.p.m. of trivalant iron. Beer's law is not rigidly obeyed, but the colour is stable between 20°–30°C, at pH 3·2 to 5·4. The reagent can be employed as a suitable reagent for the micro-estimation of trivalent iron.

The interference by a large number of inorganic cations and anions have been studied with Unicam's SP 500 spectrophotometer and the tolerance limits of the ions determined quantitatively.

272. On the Estimation of Nickel with Oxalene Diuramidoxime.

S. P. GHOSH, Patna.

It has been found that the estimation of nickel by oxalene diuramidoxime according to Feigl is the same as that by oxalenediamidoxime because of the decomposition of oxalene diuramidoxime to oxalenediamidoxime and urea under the condition of analysis. The method has, therefore, advantage over that with oxalenediamidoxime. The nickel precipitate weighed, has the formula $Ni(C_2H_5O_2N_2)_2$ and not $Ni(C_2H_6O_2N_4)_3$. From the thermolysis curve the drying temperature has been confirmed to be between 110°—200°.

273. Bismuthiol I as an analytical reagent : Spectrophotometric determination of palladium.

A. K. MAJUMDAR and M. M. CHAKRABARTTY, Calcutta.

The reagent, bismuthiol I, has been successfully utilised for the spectrophotometric determination of palladium. The colour reaction is instantaneous and the system is stable for at least 24 hours in the pH range 6 to 10 but shows no sharp peak of maximum absorption. The system obeys Beer's Law at a palladium concentration of 0·8 μg to 8·0 μg per ml at any wave length between 400 mμ and 410 mμ, giving a sensitivity of 0·08 μg of palladium per cm^2 (practical); 0·015 μg of palladium per cm^2 (Sandell). Ethyl alcohol stabilises the system against any deviation due to appearance of turbidity. A large excess of the reagent and almost all the cations and anions, except platinum, gold, copper, chromium, iron, mercury, silver, thallium, uranium, vanadate and cyanide do not interfere.

By the Job's method of continuous variation the complex appears to be formed of the reactants in 1 :1 ratio.

274. Estimation of Palladium-α-Picolinic acid as a reagent.

A. K. MAJUMDAR and J. G. SEN GUPTA, Calcutta.

Palladium is estimated directly by precipitation with a 1% solution of α-picolinic acid in the pH range 3 to 7. The precipitate has stoichiometric composition in which the palladium to reagent ratio is 1 :2 and contains 30·4% palladium. No interference occurs when mercury (Hg^{+2}), arsenic, cadmium, zinc, manganese, nickel, cobalt, vanadate, molybdate, tungstate, magnesium and barium are present. Ions such as bismuth, antimony, beryllium, iron, chromium, aluminium, thorium, zirconium, titanium, cerium, uranium (UO_2^{+2}) do not interfere if palladium is precipitated by the reagent from tartrate medium after proper adjustment of pH. Versene completely eliminates the interference due to copper, lead, calcium and strontium.

The palladium complex is stable up to a temperature of 380°C.

275. α-picolinic acid and quinaldinic acid in the separation and volumetric determination of palladium.

A. K. MAJUMDAR and J. G. SEN GUPTA, Jadavpur, Calcutta.

Palladium can be determined volumetrically after separation with α-picolinic or quinaldinic acid by dissolving the complex in an excess of standard potassium cyanide solution and back-titrating the excess of the cyanide by standard silver nitrate solution, potassium iodide being used as the indicator. The method is very rapid and quite satisfactory. With α-picolinic acid only 2 to 15 mgs. of palladium can be determined accurately and in the case of quinaldinic acid the amount of palladium that can be estimated is from 2 to 8 mgs. Higher amounts of palladium give results slightly lower than the theoretical value.

276. Estimation of palladium—Quinaldinic acid as a reagent.

A. K. MAJUMDAR and J. G. SEN GUPTA, Calcutta.

Quinaldinic acid, like α-picolinic acid, forms an insoluble salt with palladium which under a pH range of 3 to 7 can be estimated gravimetrically as $Pd(C_{10}H_6O_2N)_2$ in presence of a large number of ions with proper control of conditions. Tartaric acid eliminates the interfering effects due to iron, aluminium, chromium, beryllium, titanium, thorium, zirconium, uranium (UO_2^{+2}), bismuth, antimony and cerium (Ce^{+4}). Arsenic (As^{+3} and As^{+5}), magnesium, calcium, strontium, barium and vanadate are without effect on the reagent. Molybdate and tungstate remain in solution above pH 4, so also behave cobalt, nickel and manganese in presence of ammonium chloride. Mercury (Hg^{+2}) and cadmium, though less soluble in the cold, remain in solution when the precipitation of palladium is done from a boiling hot solution.

The palladium-quinaldinate decomposes at 353°C.

277. α-Picolinic acid and Quinaldinic acid in the Separation of Complexometric determination of Palladium.

A. K. MAJUMDAR and J. G. SEN GUPTA, Jadavpur, Calcutta.

Palladium is estimated complexometrically after separating it from almost all common ions by precipitation with α-picolinic acid or quinaldinic acid, The palladium-picolinate or the quinaldinate readily goes into solution when heated with potassium nickel cyanide and an equivalent amount of nickel ion is set free. In the case of palladium-quinaldinate ammonium chloride is required to be added after treatment with potassium nickel cyanide to keep the nickel-quinaldinate in solution. The liberated nickel is titrated with di-sodium salt of ethylenediamine tetra-acetic acid in ammoniacal medium using a solid mixture of murexide and sodium chloride as the indicator. At the end-point the colour changes from yellow to purple. The method has been applied to the estimation of both micro and macro quantities of palladium (from 0·93 mg. to 16 mgs.) and the accuracy obtained is highly satisfactory.

278. Bismuthiol II as an Analytical Reagent : Part X. Estimation of copper.

A. K. MAJUMDAR and B. R. SINGH, Jadavpur, Calcutta.

With copper, bismuthiol II forms both cuprous and cupric complexes which are stable in mineral acids, acetic, citric and tartaric acids and the cuprous complex compared to cupric is insoluble in complexone III solution as well in organic solvents. The melting points of both cupric and cuprous complexes are respectively 148°C and 198°C. As an insoluble cupric complex it is estimated from solutions having a maximum acidity of O·IN in hydrochloric or sulphuric acid and of O·5N in acetic acid. Even at a lower acidity, up to a pH of about 6·2, the precipitation of copper is quantitative but at a pH higher than 6·2 the copper complex shows an increased solubility. By the proper control of pH and by suitable masking agent, it is possible to separate copper from almost all the ions except palladium, cadmium, lead and thallium (ous).

Cuprous complex, being more stable and insoluble and having practically the same tolerance to an acid solution or to a solution at a high pH, helps towards a more complete separation of copper from all the ions stated except the thallous and bismuth.

279. Bismuthiol II as an Analytical Reagent : Part XI. Gravimetric and Volumetric determination of Cadmium.

A. K. MAJUMDAR and B. R. SINGH, Jadavpur, Calcutta.

Cadmium can be estimated both gravimetrically and volumetrically after precipitation as the Bismuthiol II complex having the composition $(C_8H_5N_2S_3)_2Cd$. The complex is stable in the acid range and the best working pH is from 3 to 7. The method affords the separation of cadmium from ions of alkalis, alkaline earths, molybdate, vanadate, tungstate, bismuth, arsenic, antimony, tin, manganese, cobalt, nickel, zinc, and other tri- and tetra-valent elements. Higher amounts of zinc usually coprecipitate. The complex is stable up to a temperature of 315°C. For volumetry, the complexometric method was found to be highly suitable with eriochrome black-T as the indicator.

280. Bismuthiol II as an analytical reagent. Part XII. Spectrophotometric determination of palladium.

A. K. MAJUMDAR and M. M. CHAKRABARTTY, Jadavpur, Calcutta.

A method for the determination of palladium spectrophoto-metrically with Bismuthiol II is described. The color reaction is instantaneous and at 20—30°C it is stable for about 24 hours when maintained at a pH between 3 and 10. The colour system shows no sharp peak of maximum absorption though, measurements can be made at any wavelength between 410 mμ and 430 mμ, preferably at 420 mμ. At this region it adheres to Beer's law at a palladium concentration of 0·4 μg to 8·0 μg per ml. The sensitivity of the reaction is 0·06 μg palladium per cm$_2$ (practical) or 0·01 μg and 0·012 μg of palladium per cm^2 at 410 mμ and 420 mμ respectively (Sandell). Acetone and methyl cellosolve stabilise the system against any deviation. Excess of the reagent and a large number of cations and anions are completely without effect. Ions that are coloured, that give coloured precipitate in the presence of complexone III or with complexone III and those that form soluble nondissociable complex with palladium interfere. The composition of the complex in solution found by Job's method agrees well with that of the compound isolated and is $Pd(C_8H_5N_2S_3)_2$.

281. Estimation of Palladium by *vic*-dioximes. Part I.

J. S. DAVE and A. N. TALATI, Baroda.

We have observed that Pd salts form a yellow-coloured metal chelate compound with a-isonitroso-S-oximino-acetoacetanilide. The composition of the complex indicates that it might be represented by the formula $Pd(C_{10}H_{10}N_3O_3)_2$. It is found that the precipitation of this complex is quantitative and hence its use in gravimetric analysis has been investigated. Palladium is found to be completely precipitated over a wide pH range (from 0·1 to 8·8). It is suggested that Pd can be estimated as the complex $Pd(C_{10}H_{10}N_3O_3)_2$ by precipitating it at pH 0·4 to 0·7, drying it at 110—120°C. and weighing as $PdC_{20}H_{20}N_6O_6$. It is observed that the cations, so far investigated, cause no interference to the estimation of Pd but that varying results are obtained in presence of iodide, cyanide and nitrate when the estimation of Palladium is carried out by the above process.

282. Separation of Niobium and Tantalum with N-Benzoyl-N-phenyl-hydroxylamine.

A. K. MAJUMDAR and A. K. MUKHERJEE, Jadavpur, Calcutta.

A study on the effect of N-benzoyl-N-phenyl hydroxylamine, for the separation of niobium and tantalum, indicates that the said reagent allows a very satisfactory estimation of niobium from a tartrate solution at an acidity of 2·ON and the pH range for its complete precipitation can be extended up to 6·5. For tantalum precipitation, the pH of the solution should be below 1·5 and the acidity may be even over 2·ON; higher pH helps to keep it in solution. At a pH of 3·5 to 6·5, niobium completely precipitates and tantalum remains in solution, from which it is precipitated by lowering the pH. By a single precipitation they are determined from a mixture containing niobium and tantalum in the ratios of 1 : 16 to 100 : 1 and by a double precipitation from a ratio of 1 : 100. Titanium, zirconium, vanadate and molybdate interfere with the determination of niobium though, other ions have no effect in presence of complexone III and tartaric acid. The precipitates are highly granular and are easy to filter and wash. The time taken for a complete analysis is much less than what is required by any other methods.

283. Volumetric estimation of the persulphate using arsenite as a primary standard.

YUGUL KISHORE GUPTA and SATYESHWAR GHOSH, Allahabad.

The method of estimating the persulphate by direct titration using arsenious acid or sodium arsenite as a primary standard has been described. The method consists in taking a mixture of arsenite or acid and an excess of KI in the titration mixture. The mixture is heated to about 80°C and solid sodium bicarbonate is added. Persulphate solution is run in from a burette and the liberated iodine is instantaneously consumed by trivalent arsenic. At the end point an excess drop of the persulphate gives a yellow colour due to the liberated iodine remaining unreacted. The results are satisfactory and the error lies within permissible limits.

284. Studies in Bivalent Chromium Salts—Part III. Standardisation of Chromous Sulphate Solution against common Oxidising agents.

J. P. TANDON and R. C. MEHROTRA, Agra and Lucknow.

It has been shown that chromous solutions can be standardised with the help of potassium dichromate, sulphato-cerate, iodate, bromate and periodate solutions. In the first two cases N-phenyl anthranilic acid, ferroin and diphenylbenzedine have been shown to serve as reversible indicators. In the cases of iodate, bromate and periodate, no suitable indication could be found. However, the reactions are quantitative and estimations can be carried out by adding an excess of chromous sulphate solution which can be finally titrated with ferrous sulphate using potassium thiocyanate as internal indicator.

285. Studies in Bivalent Chromium Sales—Part IV. Determination of persulphate, Hydrogen Peroxide and Dissolved Oxygen in water.

J. P. TANDON and R. C. MEHROTRA, Agra and Lucknow.

Further analytical uses of chromous sulphate as a volumetric reagent have been described. It has been shown that the potassium persulphate, hydrogen peroxide and dissolved oxygen in ordinary water can be estimated volumetrically with the help of chromous sulphate reagent. Two alternative procedures have been found to be applicable for the above estimations. In the first procedure, chromous sulphate (in excess) added to the solution being titrated and the excess of chromous salt is titrated with ferric solution using potassium thiocyanate as indicator. In the alternative procedure, ferrous sulphate solution is added in excess to the potassium per sulphate, hydrogen peroxide, or oxygen containing water solution and the equivalent amount of ferric ions produced is estimated by titration with chromous sulphate.

286. Spectrochemical Analysis of Aluminium Alloys by the Oxide Arc Technique.

M. K. GUPTA and B. C. KAR, Jamshedpur.

The aim of this total combustion oxide arc technique is to eliminate the structural effects and the line intensity variations due to compositional changes, in the analysis of different types of aluminium alloys. This method is based on the conversion of the synthetic solution standards of different type of aluminium alloys containing Cu, Si, Zn, Mg, Fe, Mn, Ti, Ni and Cr, and the unknown samples into powdered oxide. Twenty mg. of the oxide sample in the form of a tubular pellet is completely vapourised in 15 seconds from a supporting graphite electrode by a 4 ampere D.C. arc. The pellet contains one part of oxide sample mixed with two parts of sucrose which helps in the uniform ejection of the sample in the arc. The graphite electrode is carefully machined to form a central post surrounded by a thin wall. The tubular pellet is carefully introduced into the central post and exactly fits in the annular space between the post and the thin wall. This prevents the wandering of the arc and provides a fairly steady source of excitation. The arc current and the time of exposure are properly adjusted to have a complete disappearance of the sample with a minimum of continuous background. This burning of a small amount of sample to exhaustion produces an integrated intensity of spectrum lines proportional to the concentration of the elements in the sample and reduces the line intensity variation due to compositional changes. Line densities are measured by using plate calibration method. The results obtained in the analysis of aluminium alloys of varied composition and different metallurgical history using only one set of standards, is fairly satisfactory with regard to precision and accuracy. Standard deviation varies from 10 to 12 per cent and accuracy from 8 to 10 per cent of the amount present.

287. Effect of Impurities on the Spectrochemical Determination of Hafnia in Zirconia by Porous Cup Technique.

B. R. VENGSARKAR and R. K. DHUMWAD, Bombay.

A method for the estimation of hafnia in zirconia, in the range 0·25% to 4% hafnia by the porous cup technique is standardised. The effect of impurities like Fe, Al, Mg, Cr, Sn and Na on the estimation of hafnia in zirconia by porous cup technique has been studied. Either aluminium or magnesium when present upto 5% does not affect the estimation, whereas anyone of the following impurities viz., iron, chromium, tin and sodium present even upto 1% is likely to affect the estimation, particularly so in the lower hafnia range. The effect of a mixture of these impurities on hafnia estimation has also been studied.

288. Estimation of Iron in the presence of large Excess of Oxalic Acid.

G. V. L. N. MURTY and J. C. DUBEY, Jamshedpur.

A systematic study of the factor affecting the induced oxidation of oxalic acid by dichromate in the presence of ferrous iron, viz., concentration of oxalic acid, mineral acid, ferrous iron and the influence of temperature has been carried out. Based on these observations, a satisfactory procedure has been worked out for the estimation of iron in the presence of a large excess of oxalic acid by direct titration in the standard dichromate.

289. On the Sensitivity of Chloride Estimation by Mohr's and Fajan's Methods.

N. A. RAMAIAH and VISHNU, Kanpur.

During the course of investigation on the adsorption of water by ion exchange resins in electrolyte solutions like NaCl, etc. (Naturwiss. *43*, 543, 1956), it has been observed that the error involved in the estimation of chloridein small quantities by the familiar methods due to Mohr and Fajan, was appreciable because of the absence of a sharp end point with K_2CrO_4 or fluorescein as indicators; a mixture of these two substances gave a very sharp end point (appearance of reddish brown colour against greenish yellow colour of fluorescein). A mixture of 0·5 ml. of 5 per cent K_2CrO_4 soln. and 0·2 ml. of 1 per cent of sodium fluoresceinate soln. for an aliquot of 25 ml. appeared suitable.

290. Cyanometric Determination of Nickel in Ferrous Materials. A new titration technique.

G. V. L. N. MURTY, S. JAYA RAO and S. K. MAZUMDAR, Jamshedpur.

Investigations on the cyanometric method for the estimation of Nickel in alloy steels and other ferrous materials have shown that, owing to the presence of silica in the colloidal condition, considerable errors are introduced in judging the end-points. It has, however, been observed that when the end-point is over-stepped the silver halide forms sufficiently stable suspensions under carefully controlled conditions. The resulting turbidity, in all these cases, has been found to bear a direct relationship to the excess quantity of the titrant employed. Based on these observations, a satisfactory procedure has been worked out for the estimation of Nickel in alloy steels and other ferrous materials like Nickel-hard pig iron.

291. Polarographic Estimation of Cadmium in Presence of Ni++, Co++, Zn++, etc.

N. A. RAMAIAH and H. C. SARASWAT, Kanpur.

Possibility of using potassium ferrocyanide for estimating polarographically of Pb++, Cd++, Ni++, Co++, Zn++, etc. in KCl solution used as the supporting electrolyte was discussed. Mixture of these constituents in KCl soln. could not be analysed. Detailed work showed that Cd++ could be determined quantitatively in presence of Co++, Ni++, Bi+++, etc. in potassium citrate solution as the supporting electrolyte; the presence of Zn++, however, interfered with the analysis.

292. High Frequency Titrations.

S. N. MUKHERJEE and M. S. RAJU, Jadavpur, Calcutta.

High frequency titration method has been extended to the estimation of barium ions by titration with potassium sulphate solution. The method at first presented difficulties in the way of determination of the exact equivalence point due probably to the gradual agglomeration of the precipitate into lumps, as it was noticed that the capacity readings changed and required a lapse of time before it would be steady. This difficulty was overcome first by use of alcohol (about 30-40%) in the solution and subsequently by addition of about 1 mg. of solid barium sulphate in the solution. The use of the latter removed all difficulties and sharp equivalence point was noticeable by a break in the titration curve. Later on, it was examined whether this method of titration could be applied for estimation of barium in presence of calcium, where it was observed that the method succeeded even in cases where calcium to barium ratio was of the order of 10 : 1. Beyond this the method was found not very reliable. Further it was observed that the use of alcohol could be entirely dispensed with if we used a small quantity (1 mg./100 c.c. solution) of solid barium sulphate in the solution before starting the titration.

293. Potentiometric determination of primary aromatic amines.

RAM SAHAI SAXENA and C. S. BHATNAGAR, Kota.

Aniline and p-toluidine were titrated in presence of HCl potentiometrically against standard $NaNO_2$ solution using platinum as an indicator electrode. It is observed that the potential assumes a steady value after each addition of the reagent. The curves are regular in form, a pronounced maxima in dE/dC occurs at the point of equivalence and the results are very accurate and reproducible under certain conditions.

A solution of HNO_2 in contact with platinum electrode gives a definite potential and when an aromatic primary amine is diazotised, free HNO_2 is formed at the completion of the reaction. E. Muller and E. Dachselt (Z. Elektro Chem. *31*, 662, 1925) made a brief investigation of this titration. In this paper, a more detailed and systematic study of this reaction has been made.

With the addition of $NaNO_2$ solution to amine soln., there is a regular change in E.M.F. till at the equivalence point, a marked upward jump is observed. With concentrated solutions of reactants and at temperatures 5°, 15°, 30°C, the results are very accurate. At temp. above 30°C and with diluted solutions, no appreciable break in potential is observed at the end point.

The method of potentiometric titration is simple and rapid, and affords a quantitative method for the determination of primary aromatic amines such as aniline and p-toluidine. The method has been extended to other primary amines.

294. Conductometric and Potentiometric determination of Phosphoric Acid very dilute aqueous solution.

L. V. NABAR, S. S. MANELKAR and B. N. GHOSH, Bombay.

Neutralisation of very dilute solution of phosphoric acid with sodium hydroxide has been studied both conductometrically and potentiometrically. The first stoichiometric point of the reaction is analytically indicated by a minimum in the conductometric titration curves whereas within the limits of concentration studied the third stoichiometric points as well as the second could not be well ascertained from either the second or third inflection point of the potentiometric titration curve except when the concentration of phosphoric acid tends to 0·1 molar. The equivalence point has been determined by the method developed by Grunnar Gran and not by the usual method of plotting dPH/dv against the titer reading (titer terms corrected in each case).

295. Chemical and Flame Photometric Methods of Sodium and Potassium Determination in clays.

M. A. QUIYUM, S. RAJENDER RAO and ABDE ALI, Hyderabad-Dn.

Percentage of the total alkali oxides present in four clays of Andhra Pradesh was determined by J. Lawrence Smith method and percentages of Na_2O and K_2O separately were determined by means of flame photometer. The installation and working of the Flame Photometer was given in detail.

Calibrating curves for Sodium from 0·1—0·00125% Na_2O and potassium from 0·01—0·00125% were obtained by using standard solutions of Sodium Chloride and Potassium Chloride. The results obtained by J. L. Smith method and the Flame Photometer method were compared. Close agreement was found between these two results.

296. Separation of Columbium and Tantalum together from Titanium.

CH. VENKATESWARLU and V. T. ATHAVALE, Bombay.

The preferential formation of a stable complex of titanium with a mixture of oxalate and ethylenediamine tetracetic acid in alkaline medium is applied to separate columbium and tantalum together from titanium under suitable conditions.

297. Paper chromatography in the separation of ions.

A. K. MAJUMDAR and A. K. MUKHERJEE, Jadavpur, Calcutta.

The behaviour of the ions like Fe^{+3}, Be^{+2}, Ti^{+4}, UO_2^{+2}, Cr^{+3}, Al^{+3}, Th^{+4}, Ce^{+3}, $R.E^{+3}$, ZrO_2^{+2}, Zn^{+2}, Mn^{+2}, Ni^{+2}, Co^{+2}, VO_3^{-1}, AsO_4^{-3}, PO_4^{-3}, MoO_4^{-2}, WO_4^{-2} and CrO_4^{-2} and their separations have been studied by ascending paper chromatography using solvent mixtures of t-butylalcohol, water and hydrochloric or acetic acid in the ratios of 7 :2 :1 with or without tartaric, citric or malonic acid. The solvent mixture, using hydroloric acid as one of the component, is found to be most effective. From a mixture of six cations or three anions, it is possible to have their distinct separations. The R_L and R_F values and sequences of separations are recorded.

298. Circular-Paper Chromatography in the separation of ions. Separation of Precious metals.

A. K. MAJUMDAR and M. M. CHAKRABARTTY, Jadavpur, Calcutta.

A circular-paper chromatographic method of separation of precious metals Pd^{+2}, Pt^{+4}, Ir^{+4}, Rh^{+3}, Ru^{+3}, Os^{+4} and Au^{+3} has been studied on Whatman No. 1 filter paper with several solvent mixtures and with or without complexing agents. From mixtures of three or four such metals it is found to be possible to have their effective separation into distinct circular zones within an hour or two when present in microamounts.

299. Paper Chromatography in the Separation of ions. Part II. Separation of Precious metals.

A. K. MAJUMDAR and M. M. CHAKRABARTTY, Jadavpur, Calcutta.

A study of the separation of the precious metals, Pd^{+2}, Pt^{+4}, Ir^{+4}, Rh^{+3}, Ru^{+3}, Os^{+4} and Au^{+3}, by ascending paper chromatography in different solvents, reveals that at least four of the elements, in microgram amounts, when present in a mixture are easily separated from each other. The R_F values at different temperatures and the sequences of separations have also been recorded.

300. Paper chromatography in the separation of ions. Part III. Separation of silver, copper and arsenic group elements.

A. K. MAJUMDAR and M. M. CHAKRABARTTY, Jadavpur, Calcutta.

The behaviour of the cations of the silver, copper and arsenic groups of the general analytical table and their separation from each other has been investigated by paper chromatography with a number of solvents and with or without ammonium iodide as a complexing agent. Their R_F values at different temperatures and the sequences of separation have been recorded and found that at least five elements from a mixture can be distinctly separated when present in micro-quantities.

301. Electro-Chromatography in the separations of ions. Part III. Separation of silver group.

A. K. MAJUMDAR and B. R. SINGH, Jadavpur, Calcutta.

The migration sequences of silver group ions Ag^{+1}, Hg_2^{+2}, Pb^{+2} and Ti^{+1} have been studied in a number of complex forming electrolytes. Based on the migration sequences the ions in a mixture can be separated into distinct zones with a decinormal solution of sodium chloride, potassium chloride or potassion cyanide as the electrolyte. The sequence is Hg-Ag-Pb-Tl, while in KCN at pH 7·0 the sequence becomes Ag-Hg-Pb-Tl.

302. Electro-Chromatography in the Separation of ions. Part IV. Separation of Copper and tin Groups.

A. K. MAJUMDAR and B. R. SINGH, Jadavpur, Calcutta.

The ionic migration and hence the migration sequences of the ions of the copper and the tin groups have been determined in a number of common electrolytes which act as complexing agents. Separation of several ternary, quaternary and pentanary mixtures of copper group elements has been effected. Of the electrolytes, hydrochloric acid, sodium chloride and potassium chloride, the latter gives the best and complete separation of all the copper group ions from a mixture at a potential gradient of 150 volts maintained for 5 hours. The tin group of metals cannot be separated completely from each other under the experimental conditions, where only binary separation is possible.

303. A three component solvent system for separation of Phenol-Formaldehyde Reaction Products by Ascending Paper Chromatography.

LOURDU M. YEDDANAPALLI, A. K. KURIAKOSE and V. V. GOPALAKRISHNA, Madras.

The two-dimensional paper chromatographic technique by Reese for the separation of the bi-nuclear condensation products formed in the phenolformaldehyde reaction could not be used for their quantitative estimation by the spot weight method. The uni-directional descending paper chromatography reported by Finn and James using the organic layer of a three component system of benzene, acetic acid and water, gave elongated and uneven spots not suitable for quantitative estimation, and also required 100 hours for the separation of mono-nuclear methylol phenols.

Our investigations using various compositions of benzene, acetic acid and water showed that a single-phase three component system consisting of these solvents in the ratio of 200 :63 :1 by volume respectively could, by the ascending technique, give after 8 hours of development, circular and well-defined spots of the following compounds present in a mixture : 2- and 4-methylol phenols, 2 :4- and 2 :6-dimethylol phenols, 2 :4 :6-trimethylol phenol, 2 :2′-, 2 :4′-, 4 :4′- and 3-methylol-2′ :4-dihydroxy diphenyl methanes. Quantitative estimation of these compounds by the spot weight method has been successfully carried out for the reaction products from acid and alkali catalysed phenol-formaldehyde reaction.

304. A modified Method of Quantitative Estimation of Amino Acids by Circular Paper Chromatography.

LOURDU M. YEDDANAPALLI and A. SRINIVASAN, Madras.

A quantitative method of estimating amino acids by circular paper chromatography based on the linear relationship between the weight of the developed spot and the logarithm of the concentration of amino acid spotted has been developed. The amino acid solutions for spotting were prepared in 90% formic acid in order to control the size of the spot and to get well-defined clear bands after development with n-bunatol-acetic acid—water (40 :10 :50 by volume) and spraying with ninhydrin. Analysis of cystine, arginine, alanine and tyrosine present in a mixture in 3 to 10 microgram quantities have been carried out with an accuracy of ± 5%. In view of its simplicity this spot weight method of analysing amino acid mixtures will be of great value in a general laboratory.

305. Chromatographic Study of Metalic Ammines.

ERIC JOHN SINGH and ARUN K. DEY, Allahabad.

The movement of metal ammines through filter paper strips has been studied. Mixtures of solutions of the metal salts with NH_4Cl and NH_4OH were prepared and spotted on strips. 50% ethanol was used as the solvent. It was noted that excess of NH_4Cl when present gave better chromatograms. Increase of NH_3 concentration resulted in a change of Rf values. In the case of Cu (II) and Ni (II) the Rf value decreases, while in the case of Ag (I), Cd (II) and Co (II) it increases with increasing concentrations of NH_4OH added. With progressive increase in the concentration of NH_4OH the Rf values finally tend to become constant.

306. Chromatographic Study of Anionic Complexes. Part I. Complex Cuprioxalate.

ERIC JOHN SINGH and ARUN K. DEY, Allahabad.

In this paper the variation of diffusion, through a filter paper strip by the ascending method, of cuprioxalate complex has been studied. Various mixture of $Cu^{++} : C_2O_4^{--}$ ions have been investigated. It has been noted that till there is a precipitation, the Rf values tend to decrease and finally reach nearly to zero, when the oxalate precipitates completely. With redissolution of the precipitate to form the complex anion, Rf values increase again to a maximum and then have a slight tendency to diminish. No tailing occurs in the chromatograms in cases where the copper has passed into the anion.

307. A new Ion-exchange method of separation of Co++ from the water soluble Cobalt Complexes.

V. G. THOMAS and RAMENDRA SHANKER, Bombay.

The present studies revealed that a solution of 8% disodium salt of EDTA at pH 7·5-8·5, elutes down completely the adsorbed Co++ from Amberlite IR-120, thereby furnishing an effective method of separation of cobaltous ion from the neutral and anionic complex of cobalt like the cobaltic complexes of EDTA and potassium trioxalate. In the radiochemical separations involving Co^{60} it has certain advantages over the solvent extraction method.

308. Quantitative Precipitation studies in the aqueous non-aqueous media-Estimation of Barium Sulphate.

TARA CHAND GUPTA and ABANI K. BHATTACHARYA, Agra.

In the quantitative estimation of Ba as Barium Sulphate it has been recommended that $BaSO_4$ should be precipitated by adding sulphuric acid of Normal or 2 Normal strength, because the results are low in more diluted solutions of sulphuric acid. It has been observed that accurate results within the limits of experimental error can be obtained by precipitating Barium Sulphate in the presence of alcohol or acetone with dilute sulphuric acid upto N/6 strength. When Barium Sulphate is precipitated with dilute sulphuric acid of strength less than N/2 the results are low in the absence of Alcohol or Acetone.

309. Mercuric Acetate as an Analytical Reagent in Non-Aqueous Titrimetry.

KIRON KUMAR KUNDU and MIHIR NATH DAS, Jadavpur, Calcutta.

Mercuric acetate can be titrated with hydrochloric acid in glycolic solvent media, but not with perchloric acid. In presence of halide ions, however, mercuric halide is formed and the resulting acetate is amenable to titration with perchloric acid. Thus, halide ions can be determined indirectly by titration with perchloric acid, in presence of added mercuric acetate and vice versa. This property of mercuric acetate has been utilised for analyses of various compounds, especially mixtures.

A mixture of sodium and mercuric acetates has been determined by first titrating with perchloric acid, which gives the sodium acetate, and then continuing the titration after addition of sodium chloride. Cationic soaps like lauryl and cetyl quaternary ammonium bromides have been estimated by titration with perchloric acid in presence of added mercuric accetate. Bromophenol blue can be used as indicator for these titrations but potentiometric methods are more suitable.

Mixtures of mineral acids containing hydrochloric acid as a common constituent have been determined by first titrating the mixture in glycolic solvent with sodium acetate and then titrating the same solution with perchloric acid in presence of added mercuric acetate. Mixtures of hydrochloric with nitric, perchloric or sulphuric acid have been titrated by this method. Ternary mixtures of mineral acids containing hydrochloric, sulphuric and nitric or perchloric acids have also been analyzed by potentiometric titration. A mixture containing hydrochloric, nitric, sulphuric and acetic acids can be analyzed by a similar procedure. Presence of neutral halides interferes in all these cases.

310. Reaction of Cetyltrimethyl Ammonium Bromide with Tungstic Acid.

S K. DUTTA, Calcutta.

Phosphotungstic acid is often used to remove the protein bodies from a biological preparation but the presence of the residual tungstic acid component of the phosphotungstic acid produces difficulties during the subsequent work with that solution. Cetyltrimethyl ammonium bromide (cetrimide) was used to remove the tungstic acid as an insoluble complex formed between the two. It was found that cetrimide and tungstic acid reacted together in the molar ratio 1 :4 to form a complex compound of the probable nature $(C_{16}H_{33}N(CH_3)_3, 4WO_3, xH_2O)$.

This reaction between cetrimide and tungstic acid has also been used for estimating the tungsten in a tungstic acid solution, which compared well with the standard method using cinchonine.

During this investigation it was further noted that tungsten can also be colourimetrically estimated using ammonium molybdate in presence of 2 :4 diaminophenol and sodium metabisulphite.

311. Estimation of Tributyl Phosphate.

A. K. SUNDARAM, Bombay.

Tributyl phosphate $(C_4H_9)_3PO_4$ (TBP) is used for the extraction of uranyl nitrate, kerosene being commonly used as a diluent. The loss of the solvent has to be compensated before recycling and an estimation becomes necessary. A method of estimation of TBP is described based on the formation of a 1 : 1 complex with nitric acid. The sample is shaken with a known amount of 6M nitric acid for 20 minutes in a mechanical shaker and an aliquot of the organic phase is titrated against standard alkali. The acid reacted with TBP is then calculated. Estimations can be made within ±0·2 TBP per cent in the range of 20-45% TBP.

312. Tributyl Phosphate in Organic Solvents.

U. A. SANT and M. SANKAR DAS, Bombay.

The extensive use of tributyl phosphate as a solvent for uranium extractions, necessitates a simple and accurate method for its assay in the presence of other organic diluents like kerosene. The method recommended consists of the conversion of tributyl phosphate to inorganic orthophosphate by low temperature alkali fusion and the titrimetric determination of the latter with standard bismuthyl-perchlorate using diallyl dithiocarbamido hydrazine in chloroform as extraction indicator.

313. A Rapid Geochemical Method for the Determination of Vanadium in Indian Laterites, Rocks, Soils, etc.

B. DAS SARMA and R. K. DUTTA ROY, Calcutta.

A modified method for the rapid geochemical prospecting of trace vanadium in Indian laterites has been described. The method can be used with advantage in evaluating the vanadium content of iron ores, bauxite, rocks and soils as well. The procedure is very rapid (30 samples can be analysed in one working day) and 0·2γ of V can be estimated visually in a 2 c.c. extract. Moreover no expensive chemicals or equipments are necessary making it a satisfactory field method for geochemical analysis. The method is based on quick decomposition of the sample with caustic alkali fusion in iron or nickel crucibles, destroying manganate formed with ethyl alcohol, and estimation of vanadium as the oxinate in amyl(iso-) alcohol from the filtrate buffered with acetate-acetic acid. A little fluoride takes care of traces of iron that may be present in the filtrate. Chromium over 5γ is simultaneously estimated in the method as chromate in the filtrate of volume not over 10 c.c. A comparison of the proposed method for vanadium estimated visually with the phosphotungstate standard procedure using photo-electric colorimeter shows the results within 20% of the standard method.

BIOCHEMISTRY

314. A synthetic medium for the fermentative production of riboflabin by a mutant yeast.

ASHIS KUMAR SEN GUPTA and K. K. MITRA, Jadavpur, Calcutta.

The influence of the concentration of individual constituents of the medium on flavinogenesis and growth of the mutant yeast has been studied; a tentative medium has been used as standard for comparison. Phosphates and magnesium sulphate at lower levels of concentrations produced higher yields of riboflavin. No significant change in the yield of riboflavin was observed on lowering the concentration of ammonium sulphate in the medium from 0·4 to 0·2 per cent.

'Dextrosol' at a concentration of 3 per cent in the medium gave the highest yields of yeasts and riboflavin. Incorporation of biotin at a concentration of 1·0 μg. per litre provides adequate level of this growth factor for optimum performance by the strain. Yields of riboflavin as high as 207 μg. per ml. could be secured in the modified synthetic medium.

315. Metabolism of Sucrose by Leishmania Donovani, the Causative Organism for Kala-azar.

A. N. CHATTERJEE, (MISS) NANDITA SENGUPTA and J. J. GHOSH, Calcutta.

In course of an investigation into the role of different carbohydrates on the metabolic activity of *Leishmania donovani*, the causal organism of Kalaazar, a strong sucrose hydrolyzing enzyme has been detected in the cell-free extracts of this organism. Both chemical and paper chromatographic analyses reveal that only glucose and fructose are formed in the reaction mixture with no concomitant or intermediary formations of either phosphorylated sugars or polysaccharide or oligosaccharide like substances. The liberation of free fructose and glucose suggests that the enzyme might be of purely hydrolytic glycosidase type, according to Hoffman-Ostenhof's nomenclature. It seems therefore that the extracts of *L. donovani* possessed a greater hydrolytic tendency than the corresponding mould enzyme, as studied by Bacon and Edelman. The pH optima, enzyme-substrate relationship, Michäelis constant, inactivation temperature, co-factor requirements etc. of the enzyme, present in cell-free extract, have been studied in detail.

316. Studies on Sulphonyl-Urea derivates.

P. R. GUPTA, S. L. MUKHERJEE, S. L. LASKAR,
and
S. ROYMAHASAYA, Calcutta.

The recent introduction of Carbutamide (p-NH_2-$C_6H_4SO_2NHCONHBu$) and Tolbutamide (p-CH_3-$C_6H_4SO_2NHCONHBu$) in the oral treatment of diabetes mellitus has been a remarkable advance in the science of Chemotherapy. With a view to study the anti-diabetic activity of the compound, obtained by introducing a -CH_2- group in between the amino group and benzene nucleus, the following compound was synthesised :—

$$NH_2\text{-}CH_2\text{-}C_6H_4\text{-}SO_2NHCONHBu.\ (n).$$

The compound was prepared by reacting p-acetaminomethyl-benzene sulphonamide with n-butyl isocyanate and hydrolising the product N'-p-Acetaminomethyl benzene sulphonyl-N^3-butyl-urea formed with dil. caustic soda solution.

The compound (Homo-Carbutamide)[1] showed no hypo-glycemic activity when tested on laboratory animals.

317A. Chemical and Bacteriological Analysis of Drinking water of Kurseong.

SATYA RANJAN SARKAR, Darjeeling.

The drinking water of Kurseong was analysed chemically and bacteriologically for the whole year from Oct. 1956 to Sept. 1957 to find out seasonal variations, if any. In Kurseong water is supplied from intermittent springs. After settling impurities are removed with alum, then filtered and chlorinated with bleaching powder. All the constituents are low as the source is spring water. Most of the constituents were low in the dry season, increased in the wet season, again decreasing as dry season comes. The results are expressed in parts/100,000.

Total solids showed 3·5 and 2·85 (average values) in the dry and wet season. Chlorides did not change much during the year, showing average value 0·9. Total, permanent and temporary hardness showed 6·5, 5·0, 1·0 (average values) in the dry season, increasing to 8·2, 6·5, 1·6 (average values) on the rainy season again decreasing as dry season comes. Free and saline ammonia did not change much during the year showing average value of 0·0047 and 0·0052 in the dry and wet seasons respectively.

Albuminoid ammonia and oxygen absorption figures showed average values of 0·0092 and 0·08 in the dry season which increased to 0·02 and 0·32 (average) in the wet season. Nitrate showed average value of 0·09 in the wet season increasing to 0·18 in the wet season. Sulphate etc. and poisonous metals were absent all the year.

Bacteriological examination showed satisfactory results in the dry season, plate count 15/cc (average), and presumptive coli form count nil. In wet season average plate count was 80/cc and presumptive coli form count was 1/100 cc.

317. Poly Unsaturated Fatty Acids of Human Blood serum of different age groups.

B. S. PATIL & N. G. MAGAR, Bombay.

Ten human blood samples of each age group 30-40 and 40-50, were studied for their serum unsaturated fatty acids by alkali isomerization and absorption spectrophotometry. In the age group of 30-40 years, the average percentage of linoleic, linolenic, arachidonic, pentaenoic and hexaenoic acid was 24·2, 1·40, 6·40, 0·64 and 1·14 respectively. Similary in the age group of 40-50 years, the average percentage of linoleic, linolenic and arachidonic, pentaenoic and hexaenoic acid was 22·3, 1·64, 7.43, 0·77 and 1·82 respectively. Average total fatty acids of the two groups were 340·0 and 351·0 mg per 100 c.c. of serum respectively.

318. Studies on the enzymic activity of Papain. Part I. Groundnut Cake protein as substrate.

G. C. ESH, Calcutta.

With groundnut cake protein as the substrate the enzymic activity of Papain has been studied under different pH conditions (pH 4·5—7·0) and buffer concentrations and in the influence of activators like thiosulphate and sodium metabisulphite. Within this pH range conditions the rate of proteolysis tends to be higher with higher pH. This rate is enhanced by the addition of buffers and/or activators although the influence of activators seems to be less than that of the buffers. The rate of peptidase activity of the enzyme seems to move in the opposite pH condition leading to highest degree of hydrolysis at the lower pH range. The addition of buffer and/or activators although enhance the release of total quantity of -amino acids the rate is not sufficient to increase the overall degree of hydrolysis. In short the results tend to show that while papain is quite efficient in proteolytic activity and this activity can be significantly raised by buffers and/or activators, its peptidase activity is limited and cannot be raised to the extent of raising sufficiently the degree of hydrolysis. Implications of such actions have been discussed.

319. Role of the tannins of *Phyllanthus Emblica* (Amla) in stabilizing the Ascorbic acid of the fruits of this plant.

H. D. BRAHMACHARI and V. S. GUPTA, Pilani.

It has been reported earlier (Proc. Ind. Sc. Cong. 1957) that the edible portion of the fruits of Phyllanthus Emblica (Amla) contain Ascorbic Acid (Vit. C) in a form in which it is not destroyed, as is the case with the other common sources of this vitamin, by processes like grinding and drying in the sun. The sundried powder retains the full amount of ascorbic Acid as is present in the fresh fruit.

Some investigations were carried on to find out the nature of such stabilization and the stabilizing agents. The sundried powder of the edible portion of the fruits of *phyllanthus Emblica* was found to contain 26% tannins and gallic acid estimated colorimetrically in terms of Pyrogallol. Further experiments revealed that the *tanninfree* extract in 1% oxalic acid of this sundried powder lost its ascorbic acid far more rapidly than a simple extract (containing the tannins) in the same extracting medium under similar conditions. Results of titration against 2:6 dichlorophenol-Indophenol showed that a soln. of cryst. Ascorbic Acid (B.D.H.) in 1% oxalic acid lost all the reducing power in 55 hrs., while an extract of the sundried powder under similar conditions lost only ⅓rd activity in 75 hours but when the tannins were completely precipitated from this extract all activity was lost in 75 hours; all the flasks being always kept in the refrigerator.

320. On the standards of Ghee in Darjeeling Area.

SATYA RANJAN SARKAR, Darjeeling.

Forty different samples of pure ghee of the hill areas of Darjeeling collected from four different sources (ten samples from each source) were analysed for B.R.R. and Reichert value to verify if the prescribed standard of Government of India, under the Prevention of Food Adulteration Rules, 1955 are reasonably applicable to them. Twenty different adulterated samples were also analysed.

In samples 1 and 2, B.R.R. at 40°C varied from 44·0 to 42·8 (average 43·5) and 44·0 to 42·0 (average 43·0), Reichert value from 25·5 to 24·3 (average 24·6) and 26·7 to 24·9 (average 25·1) respectively. In samples 3 and 4, B.R.R. at 40°C varied from 43·4 to 42·4 (average 42·9) and 44·2 to 43·0 (average 43·6), Reichert value from 26·0 to 24·1 (average 24·5) and 27·7 to 25·1 (average 25·6) respectively. The adulterated samples showed average B.R.R. 48·5 and average Reichert value 10·6 respectively.

Thus no sample showed Reichert value 28, maximum value noted being 27·7 and the general average 25·4. Therefore Reichert value of samples of ghee in the hilly areas of Darjeeling where only cow ghee is available may reasonably be fixed as "not less than 24." The general trend of B.R.R. values was on the increasing side. Thus B.R.R. values at 40°c of ghee samples of the hilly areas of Darjeeling may reasonably be fixed as between 41·0 to 44·0 respectively.

321. On the Standards of Ash (total, soluble and insoluble) of Tea in Darjeeling.

SATYA RANJAN SARKAR, Darjeeling.

Fifty different samples (15 stalky tea, 20 dust tea and 15 leafy tea) in Darjeeling area were analysed for total ash, soluble ash and acid insoluble ash to verify if prescribed standards of Government of India under the Prevention of Food Adulteration Rules, 1955 are reasonably applicable to them.

In stalky tea total ash varied from 5·3 to 7·4% (average 6·3) soluble ash from 43·6 to 69·0% of total ash (average 51·4) and acid insoluble ash from 0·09 to 0·55% (average 0·31) respectively.

In leafy tea total ash varied from 5·4 to 7·3% (average 6·1) soluble ash from 46·7 to 68·5 (average 54·8) acid insoluble ash from 0·07 to 0·56% (average 0·29).

In 17 samples of dust tea total ash varied from 6·0 to 7·8% (average 7·1) soluble ash from 41·1 to 60·2 (average 48·6) and acid insoluble ash from 0·61 to 0·92% (average 0·73) respectively. 3 samples of dust tea adulterated with sand showed

total ash 8·5, 10·2 and 12·1, soluble ash 39·7, 35·7 and 32·4 and acid insoluble ash 2·0, 5·2 and 4·6 respectively.

Thus from above, the standards for total and soluble ash may not be questionable. The prescribed upper limit of 1% for acid insoluble ash which denotes the presence of extraneous sandy matter is not questionable for dust tea but the limit is rather high for stalky or leafy tea allowing adulteration with sandy matter. This may be reasonably be fixed to 0·5% on dry sample basis.

322. The Acid Insoluble Ash in Black Tea.

N. RAJASEKHARAN, K. VISWESWARIAH, R. NAGARAJAN, N. CHANDRASEKHARA, K. E. EAPEN, K. K. GOPALAN, R. VENKATESWARA RAO, C. P. NATARAJAN and D. S. BHATIA, Mysore.

Samples of tea giving more than 1% acid-insoluble ash from amongst 650 samples of black tea were analysed for extraneous silica by flotation test with chloroform. The extraneous silica in the total acid-insoluble ash in these samples ranged from 49% to 99·6% showing thereby the necessity of differentiating extraneous silica from the silica present in tea leaf while analysing tea for acid-insoluble ash. The acid-insoluble ash in tea ranged from 0·01% to 5.78% with an average of 0·41%.

The need for management to exercise care in the manufacture of tea is also stressed with a view to avoid contamination of tea with extraneous dust.

323. Utilization of certain organic acids in chick embryo liver.

NRIPENDRA LAL LAHIRY, CLARENCE VAUGHN and LAWRENCE M. MARSHALL, Mysore and Washington (U.S.A.)

From earlier experiments on the fate of C^{14} labeled bicarbonate in chick embryo liver it seemed of interest to study the utilization of citric acid in this biological system. To this end citric acid 1, 5 C^{14} was incubated with liver homogenates from 11, 14 and 17 day chick embryos. Disposal of the acid on the 14th day was greater than on the 11th and that on the 17th day was greatest of the three periods sampled. The results with administered dicarboxylic acids were not so related to embryonic development. Full results will be discussed in the paper.

324. Carbohydrate Metabolism in Heart tissue.

N. L. LAHIRY, Mysore.

Experiments were carried out to examine the disposal of radio-active glucose-1-6 -diphosphate by heart tissue. The general plan was to expose the labelled substrate to the tissue and to follow the fate of the labelled carbon atom by isolating the intermediates. Phosphorylated sugars were separated on Dowex 1×8, 100-200 mesh. The resin was converted to the formate form by either ammonium formate, method of Abood or by 2M sodium formate, method of Horecker. Whole hearts as well homogenates of the 17 day chick embryos were incubated with radioactive substrates. The greater part of the radio activity was found to reside in fraction Nos. 63, 65 and 67. This indicates that part of labelled glucose-1-6-diphosphate was oxidised via oxidative pathway in embryonic heart tissue.

325. Studies in the Non-Enzymatic Browning of Food Products : Sugar-organic Acid model systems.

N. S. KAPUR, B. S. BHATIA, D. S. BHATIA and GIRDHARI LAL, Mysore.

The non-enzymatic browning in sugar-organic acid model systems has been investigated. Changes in the ultraviolet absorption spectra, fluorescence and visible colour during storage at 55 ± 1°C of molar solutions of ten organic acids and four sugars, taking one organic acid and one sugar at a time (40 sets) have been studied. It is found that organic acids accelerate the production of hydroxy methyl furfural from hexoses. Oxalic acid-fructose complex shows maximum browning.

326. Effect of Vanillin on Stability of Vegetable Shortening.

K. M. NARAYANAN, N. S. KAPUR, G. S. BAINS and D. S. BHATIA, Mysore.

The effect of vanillin on the stability of vegetable shortening (m.p. 37°C) was studied under accelerated conditions of storage at 100°±2°C by chemical and organoleptic tests.

Vanillin has been found to possess anti-oxidant properties when incorporated in the shortening.

The interference of vanillin in the Kreis test has been observed; there was no interference in the peroxide values determined by the iodimetric methods.

327. Fortification of common salt with Calcium.

H. S. R. DESIKACHAR and V. SUBRAHMANYAN, Mysore.

Common salt was mixed with different calcium salts and stored in chambers with different humidities. Calcium carbonate was found to impart a greater hygroscopicity to the salt. Calcium sulphate and phosphate either singly or in combination were found to be suitable as their addition to salt was not detrimental to the keeping quality or edible properties of the salt. These were added at levels to contribute 2% of calcium to the salt, and when the fortified salt was incorporated along with the poor rice diet, very good growth responses were observed indicating that the calcium supplements were available for growth. The possibility of using such fortified salt as a means of improving the calcium nutrition of the poor rice diet is indicated by the study.

328. Studies on Calcium fortification of rice.

R. RADHAKRISHNA MURTHY, H. S. R. DESIKACHAR and
V. SUBRAHMANYAN, Mysore.

The calcuring of paddy by soaking in calcium chloride solution and then steaming it gave very low recoveries of added calcium in the finished rice. If the same treatment was given to milled rice, the calcium retention was higher but the rice cracked on drying. The mixing of milled or parboiled rice with calcium carbonate could not also be used as a practical method since the added calcium was easily leached out by washing prior to cooking. The preparation of a premix rich in calcium which could be added to rice at a large dilution (1 :250) to increase its calcium level to about 100 mgs.% was therefore investigated in great detail. A suitable premix could be prepared from a composition containing 15% wheat flour and 85% calcium carbonate. The premix could stand washing with water without losing its calcium.

329. Estimation of organic sulphur in Asafoetida.

L. V. L. SASTRY, Mysore.

Sulphur containing compounds which are the important constituents of the oil fraction of asafoetida have been recognised among the major factors contributing to its characteristic odour. It was therefore of interest to find if the quality of asafoetida could be assessed from the determination of sulphur present in organic combination (mostly in disulphide form). The procedure involves initial reduction to hydrogen sulphide of the sulphur component present in an aliquot of the aqueous emulsion of the sample with zinc and acid. Subsequently, the hydrogen sulphide formed is quantitatively converted to methylene blue by reaction with p-amino dimethylaniline hydrochloride in the presence of an oxidising agent like ferric ammonium sulphate. The methylene blue formed is estimated with a spectrophotometer (at 670 mμ) or with photoelectric colorimeter using filter No. KS 66. The conditions for the procedure have been standardised and the sulphur contents of the various brands of asafoetida, e.g. Irani, Pathani and Hingra as also of the samples from the local market were estimated. It was observed that there is no strict correlation between total sulphur, alcohol extractives or total ash on the one hand and on the other, the sulphur content of the different brands as determined by this method. In general, Pathani Hing samples contain higher sulphur contents (range 0·67 to 2·43 per cent) than Irani Hing samples (range 0·19 to 0·95%) or Hingra (0·28%). Hingra is unique in that it contains 69·6 per cent alcohol solubles and only 0·28 per cent sulphur while "Nayazamin 1" and "Kabulidana 1" contain 58·9 and 57·7 per cent alcohol extractives but 2·43 and 1·25 per cent sulphur respectively. The samples procured from the market contain very low sulphur contents (variation 0·07 to 0·23 per cent) suggestive of gross adulteration. Thus the sulphur content facilitates differentiation among many samples though it does not bear out price structure, if it is a measure of quality.

330. Hypoglycaemic Sulphonamide.

S. J. DAS GUPTA, Calcutta.

During a clinical trial of the Chemotherapeutic action of p-aminobenzene sulphonamido-isopropyl thiodiazole, Janbon noted that this compound produces a fall in the blood sugar level. This discovery led other workers to investigate the hypoglycaemic property of some sulphonamide compounds and it was found that p-aminobenzene sulphonamido butyl urea has a similar effect on blood sugar level. This compound was more fully investigated in man and on preliminary clinical experiments, it gave remarkable results in diabetes mellitus. Later more extensive clinical investigations in American and British hospitals have proved the compound to be a very potent drug in diabetes of elderly people of recent origin not complicated by acidosis or ketosis. This compound has now been introduced into medicine under various trade names e.g. Carbutamide, BZ-55, Nadisan, Invenol etc. The author has found out a method for its synthesis which has been described in this paper. Butyl urea was prepared by reacting n-butylamine with nitro urea at 40-45°C in aqueous solution and concentrating the solution in vacuum. Butyl urea (1·2 mol) and sulphanilamide (1 mol) were heated together at 160-165°C for several hours and the mixture on being treated with cold water and acidified with acetic acid gave a solid which was crystallised from methyl alcohol.

331. Identification of sugars in the fruits of some members of the Rosaceae family by paper chromatography.

J. C. GUPTA, Muzaffarnagar.

Using upper layer of a mixture of n-butanol, acetic acid and water (4 :1 :5) as solvent and benzidine reagent for the detection of sugar spots, R_f values of eight sugars were estimated by descending paper chromatography.

Sucrose, glucose and fructose were found to be present in strawberry (*Fragaria vesca* L.) wild strawberry (*Fragaria indica* Andr.) and apricot (*Prunus armeniaca* L.); maltose, glucose and fructose in cherry (*Prunus cerasus* L.); and glucose and fructose only in wild raspberry (*Rubus ellipticus* Smith).

332. Ascorbic Acid (vitamin C) content of some fruits and vegetables grown in the Desert areas of Rajasthan.

H. D. BRAHMACHARY and C. B. SHARMA, Pilani.

The Ascorbic Acid (vitamin C) content of twenty seven samples of fruits and vegetables grown in the desert areas of Rajasthan was determined by the various available methods, viz. titration of a metaphosphoric acid extract of the sample with 2 :6 dichlorophenol indophenol; H_2S reduction of the dehydroascorbic acid followed by indophenol titration; condensation with 2 :4 dinitrophenyl hydrazine; and formaldehyde condensation. Of all these methods condensation with 2 :4 dinitrophenyl hydrazine method as given by Roe. et. al. was found to be the best for the determination of total ascorbic acid content of fruits and vegetables. The different leafy vegetables, chillies and some fruits which are grown widely and are extensively used in Rajasthan were found to be good sources of vitamin C. Special mention may be made of a particular fruit called locally as "Teat" (caprice Aphyla) which grows wildly in the desert area and is used very extensively by the local people. It contains 176·23 mgms. of ascorbic acid per 100 gms. of the fresh fruit. Domestic methods of storage of most of these fruits and vegetables in the cold season (48°F, average) for about twenty days was found not to alter the ascorbic Acid content to any considerable extent. ...

333. Proximate Chemical composition of some cereals and pulses grown in Rajasthan.

H. D. BRAHMACHARY and C. B. SHARMA, Pilani.

The most important cereals and pulses growth in Rajasthan were analysed for their moisture, protein, ether soluble matter, carbohydrates, ash, and Vitamin C contents by using the standard methods.

Protein content was calculated from the Nitrogen content as determined by the micro-kjeldahl method; total ether soluble matter was determined by extraction in a soxhlet, the mineral content was determined by ashing, moisture was determined by heating in an electric oven; vitamin C content was determined by Indophenol titration and carbohydrate content was calculated by difference.

Bajra, the most important cereal of the locality was found to be somewhat deficient in the protein content but richer in the ether soluble matter as compared to heat. "Kheranti"—a particular type of cereal which is extensively used by the local people as energy giving food was found to contain 10·45% fat (ether soluble fraction); 4% ash; 9·3% Protein (N×6·25); 8·62% moisture, and 67·63% of carbohydrates. Analyses of Mung, Urd, Rajmah, Gowar, Moth, Chola, and Juar were also carried out.

334. Chemical Analysis of the fruits of 'Phyllanthus Emblica' (Amla).

H. D. BRAHMACHARI and V. S. GUPTA, Pilani.

The fruits of *Phyllanthus Emblica* (Amla) has been reported (Proc. Ind. Sc. Cong. 1957) to be a very good natural and readily available source of Ascorbic Acid (Vit. C). Further work has been carried on to determine the other chemical constituents of the fruits. Modern methods of plant analysis were employed for these determinations. Some of the main findings are detailed below :—

1. Seeds	8·950	gms/100 gms. of fresh whole fruit
2. Moisture	82·50	gms/ ,, ,, ,, ,,
3. Ash	0·414	gms/ ,, ,, ,, ,,
4. Total organic matter	8·469	gms/ ,, ,, ,, ,,
5. Petroleum Ether soluble matter ...	0·2001	gms/100 gms. of dry powder of the edible portion of the fruits
6. Ether soluble matter	0·7853	gms/ ,, ,, ,, ,,
7. Chloroform soluble matter ...	0·8895	gms/ ,, ,, ,, ,,
8. Absolute Alc. soluble matter ...	46·6075	gms/ ,, ,, ,, ,,
9. Ethyl Acetate soluble matter ...	14·7500	gms/ ,, ,, ,, ,,
10. Matter insoluble in the above solvents.	36·7676	gms/ ,, ,, ,, ,,
11. Total Proteins (N×6·25)	4·651	gms/ ,, ,, ,, ,,
12. Free reducing sugars	1·967	gms/ ,, ,, ,, ,,
13. Total hydrolysable carbohydrates and glucosides (other than the free reducing sugar)	0·377	gms/ ,, ,, ,, ,,
14. Total calcium	0·3291	gms/ ,, ,, ,, ,,
15. Total Phosphons	0·3741	gms/ ,, ,, ,, ,,
16. Total Iron	0·0785	gms/ ,, ,, ,, ,,
17. Total Tannins expressed as 'Pyrogallol'.	13·66	gms/ ,, ,, ,, ,,
18. Total gallic Acid expressed as 'Pyrogallol'.	12·67	gms/ ,, ,, ,, ,,

It has been already reported that the ascorbic acid of these fruits is not destroyed by "Sundrying" and that the dry powder retains the ascorbic acid potency almost indefinitely. Recent experiments have proved that the tannins of the fruits are somehow responsible for this property of retention of the ascorbic acid potency. The role of the taninns in this respect are being investigated thoroughly.

335. Prothrombin in relation to vitamin K.

GAURANGA ROY, NARENDRA NARAYAN CHAKRAVARTY and S. C. ROY,
Calcutta.

Highly purified prothrombin has been obtained from bovine blood with an activity of 1600-1800 units per mg. of dry weight. The electrophoretic pattern of the prothrombin has been obtained in a Tieselius Electrophoretic Apparatus. The amino acid composition has also been determined. On treatment with ultrasonic waves or Weber's solution, prothrombin preparation has yielded a fraction having vitamin K-like activity, though in the parent prothrombin this activity, as determined biologically or chemically—was absent. The fractions thus obtained have since been purified—one into crystalline and the other into oily form, both of which have vitamin K-activity. Ultraviolet and infra-red absorption studies of the crystalline and oil product indicate a napthoquinone structure as possessed by vitamin K.

336. Pathways of Glucose Dissimilation by Streptomyces olivaceus.

P. K. MAITRA and S. C. ROY, Calcutta.

Evidence has been put forth for the existence of glycolysis and the hexose monophosphate shunt during glucose breakdown by *Streptomyces olivaceus*, a vitamin B_{12}-producing actinomycetes. Sodium iodoacetate, sodium fluoride and sodium arsenate had been found to depress the uptake of inorganic phosphorus from a casein hydrolyzate-beef extract—glucose medium to the extent of 50% during a 96-hr. fermentation period. Analysis of phosphorylated intermediates showed that iodoacetate and arsenate caused triose phosphate to accumulate, while phosphopyruvate formation was inhibited in presence of fluoride. Experiments with resting cells indicated the existence of an iodoacetate-insensitive respiration in presence of glucose, the pattern of which closely parallelled the utilization of ribose during a 120-hr. life period of the organism. Cell-free extracts oxidized glucose-6-phosphate and 6-phosphogluconate in presence of added triphosphopyridine nucleotide, whereas added diphosphopyridine nucleotide failed to elicit the same response.

337. Triterpenoid sapogenins of Aegiceras majus Gaertn: Identity of Kanjalagin with Genin—A.

K. VENKATESWARA RAO and P. K. BOSE, Calcutta.

Kincl and Gedeon (Arch. Pharm., 1956, *289*, 221) reported a new triterpenoid sapogenin, kanjalagin, $C_{10}H_{52}O_3$, m.p. 230-232° from the bark of *A. majus* Gaertn (syn. *A. Corniculatum*, Blanco) and claimed that it gave no colour with tetranitromethane. It appeared therefore that the compound might prove to be a member of the friedelane group of triterpenes occurring for the first time in nature as a saponin. We have found, however, that it forms a triacetyl derivative, $C_{36}H_{56}O_6$, m.p. 157-159°, $(\alpha)_D$ $-9{\cdot}2^\circ$ ($CHCl_3$) which on hydrolysis gave the pure sapogenin, m.p. 238-240°, $(\alpha)_D$ $+29{\cdot}4^\circ$ (absolute ethanol) undepressed in m.p. with an authentic sample of genin-A. Both the sapogenin and its acetate gave a yellow colour with tetranitromethane, though the colour with the former was less intense in view of its sparing solubility in chloroform. Work on other unsaturated triterpenoid sapogenins and a flavonoid isolated from the same source is in progress.

338. Seed proteins of the Ocimum family.

M. A. SHAIKH, V. G. SONAR and V. A. PATWARDHAN, Sangli.

The non-fatty matter of the seeds of Ocimum sanctum, gratissimum, Canum, basilicum and Kilimandscharicum along with linseed (all drying group), was analysed by the application of circular paper chromatography and the following amino-acids were found to be present in each case :—Leucine, Phenylalanine, Valine, Tyrosine, Proline, Alanine, Glutamic acid, Serine, Arginine and Histidine. Ocimum Kilimandscharicum and linseed showed the presence of Lysine; Ocimum gratissimum showed the presence of Tryptophan as additional amino-acids to the above mentioned group.

The amino-acid contents of Ocimum Kilimandscharicum and linseed appear to be in identical state and that of Ocimum sanctum, Canum, basilicum and gratissimum appear to be in identical state. Tryptophan in Ocimum gratissimum is in much smaller proportion. The iodine value which is indicative of the fatty content may be carrying a co-relation with the protein content of the seed.

339. A New Method of Desalting Biological Fluids.

P. DAS, J. DUTTA and K. MUKHERJEE, Calcutta.

Desalting of amino acids in biological fluids, particularly urine, as a preparatory step towards quantitative analysis, has always posed a difficult problem. The existing methods of desalting are either time consuming or lack the precision required in dealing with micro-quantities of biological fluids. There invariably results some amount of loss of the amino acids.

In course of our investigations regarding amino-acid-uria in rats' urine following lethal and sub-lethal exposures to whole body gamma radiation, a new method of desaltification was developed.

Micro-quantities of urine were desalted by the technique of paper-electrophoresis. 0·5 ml. of urine was spotted on filter paper strips (whatman no. 1 or no. 3) and N/10 HCl was used as electrolyte. By applying a voltage of 200 Volts for 3 hours, complete separation was achieved.

Better results were, however, obtained by using as electrolyte, a freshly prepared 2 : 1 (v/v) mixture of pyridine and N/20 HCl. In this method the amino-acid zone was considerably removed from the inorganic salts within two hours with an applied voltage of only 50 volts. In both the cases the amino-acids formed a very narrow zone on the paper strips from which the amino-acids could be easily eluted without any loss.

340. Effect of Glucose-Cyclo-Acetoacetate on Alloxan diabetes in hypo and hyperthyroid rats.

E. P. M. BHATTATHIRY and M. C. NATH, Nagpur.

It has been found that a dose of 30 mg. of alloxan/kg. body weight is sufficient to produce diabetes in hyperthyroid rats whereas a dose of 40 mg./kg. body weight is necessary for normal rats and 70 mg./kg. body weight for thiouracil fed (hypo thyroid) animals, all injections being intravenous.

The sodium salt of glucose-cyclo-acetoacetate has also been found to protect hyper thyroid rats from the incidence of alloxan diabetes. The percentage of prevention varies with the change in the proportion of glucose-cycloacetoacetate to alloxan. When the sodium salt of glucose-cyclo-acetoacetate and alloxan are given in 3 : 1 molar proportion, the prevention of the alloxan diabetes was 87·5% in normal, 100% in hypo thyroid and 62·5 in hyperthyroid rats.

341. Studies on the meteabolic role of medicinal (Ayurvedic) calcium preparations. I. Their effect upon growth and calcium balances.

D. B. MOTLAG and M. C. NATH, Nagpur.

Effect of different calcium preparation as Mukta-Bhasma, Pravala-Bhasma and Shankha-Bhasma upon weight growth and calcium balance of rats has been studied and compared to that of calcium carbonate and calcium lactate.

It was observed that rate of gain in weight as well as the total gain in weight was higher in the groups receiving Praval Bhasma and Mukta Bhasma than that observed in groups receiving other calcium salts.

There is a close relationship between the calcium balance and weight growth. The absolute amount of calcium retained increases as the weight increase.

Relation of calcium retention to calcium intake and growth in weight of different calcium salts has been compared. In both cases Mukta Bhasma and Pravala Bhasma seem to give better results.

Effect of these calcium preparations upon phosphorous balance has also been studied and discussed.

342. Residual DDT and Gammexane on treated food grains.

S. N. MITRA and S. C. ROY, Calcutta.

In continuation of the authors' earlier work on residual DDT on preserved potatoes, further study was undertaken on the insecticide residues remaining on food grains, cereals and pulses. The organic chlorine method of the A.O.A.C. was used to estimate DDT and gammaxane and the aluminium chloride colorimetric method was employed to distinguish between DDT and gammexane.

It was observed that rice contained none of these insecticides, wheat contained from nil to 10·65 p.p.m. DDT with an average of 2·38, and pulses contained from nil to 5·68 with an average of 1·85.

This shows that a close watch should be kept on the insecticide residues on food grains, and further samples are being examined.

343. "Gammexane" and cattle ticks.

D. D. NAGPAL, Junagadh.

Gammexane, D.919 containing 13% of gamma isomer, when fed orally to bovines in doses of 0·25 gm/kgm. body wt. on the first day followed by 0·125 gm/kgm. body wt. on the 2nd, 8th and 15th day was found to kill tick in all stages of its life cycle. Cent per cent mortality was recorded among ticks on the 14th day and it protected the animal from re-infestation for a period of 40 days.

Calves fed with four doses of P.530, containing 6·5% of the gamma isomer, at 0·125 gm/kgm. body wt. every fourth day caused 100 per cent mortality among ticks on the 10th day after the first dose and the animal remained free from ticks for a further period of 12 days. While dosing at the rate of 0·25 gm/kgm. body wt. every 4th day killed ticks on the 6th day and protected the animal from re-infestation of ticks till 26th day.

Gammexane, when fed even at a low rate of dosage to milch cattle, is excreted in the milk in quantities sufficient to prove lethal to a batch of laboratory-bred flies, *Musca domestica.*

The experiments were carried out on animals showing natural infestation with ticks of the species *Boophilus microplus,* at Mukteswar-Kumaun, altitude 7,500 ft.

344. 'In vivo' Digestibility test for Shall-Seed-Oil.

D. MISRA, Sambalpur.

The co-efficient of digestibility of Shall-Seed oil has been studied along with Polson butter and Ground-nut oil. Omnivora animals such as guinea-pigs and rabbits were selected. The experiment was spread over three periods. It was found that the co-efficient of digestibility or the percentage of utilisation in case of guinea-pigs is slightly greater than in case of rabbits. The crude and refined Shall-Seed oil as regards their digestibility are quite comparable with the butter fat.

345. Distribution of Phospholipids and Cholesterol in normal (and diseased) human beings in the age group 30—60.

MANI JATTANI and N. G. MAGAR, Bombay.

32 samples of blood serum from normal male persons with low in-come group have been analysed by standard methods for total phospholipids, lecithin, sphingo-

myelin, cephalin, total and free cholesterol, their age, income, weight, profession and diet have been recorded. 30 samples from diseased males and 16 from females have also been analysed, their diagnosis of ailment and age were recorded. It was found that the range of variation of all phospholipids and cholesterol in each different age group was great. On an average there was a gradual increase of total cholesterol in the age from 30-60. Low cholesterol values were regularly accompanied by low phospholipids and vice-versa. The percentage of cephalin in blood serum of human beings was very low. The results for diseased subjects showed too much variations in phospholipids distribution.

346. Search for new insecticides—Part II. Thiocyanation of secondary Thiazolyl-Amines.

G. N. MAHAPATRA, Cuttack.

Eight 2-aryl substituted amino 4-aryl thiazoles prepared earlier have been directly thiocyanated with help of nascent thiocyanogen prepared from ammonium thiocyanate and bromine, in acetic acid medium. The position of the thiocyanato group has been ascertained to be at the 5th carbon atom of the thiazole nucleus. The possible mechanism of the thiocyanation has been furnished. Some of the thiocyanated compounds have been tested for their insecticidal properties over adult insects. *'Aphis as clepiadis passerni'* found on the leaves and stems of *Pergularia extensa Br* and have shown some insecticidal properties.

347. Studies on Soluble Enzymes in Penicillin Fermentation Broth III. Pectic Enzymes.

KARTAR SINGH, B. N. GANGULY and D. Ghosh, Pimpri.

The formation and elaboration of pectic enzymes into the fermentation Broth by the mould *Penicillium Chrysogenum* during commercial penicillin fermentation has been studied. Crude preparations from filtered broth and mycelia as well as purified enzymes showed very little pectin esterase activity, but caused rapid fall in the viscosity of pectin and pectic acid solutions without causing any significant increase in reducing groups.

The viscosity reducing activity was found to be mostly (about 90%) in the Broth filtrate. Chromatographic analysis showed that D-galactaronic acid was not formed as the end product. The P. Chrvsogenum enzyme thus appeared to be a pectin depolymerase and resembled some depolymerase from other fungal sources.

Properties of the purified P. Chrysogenum depolymerase such as pH optimum, effect of cations, stability etc. have been studied.

348. On the phase equilibria of PP' DDT in Binary systems.

M. V. KUBER, S. B. KULKARNI and A. B. BISWAS, Poona.

The phase equilibria of PP' DDT (para-dichloro diphenyl trichloroethane) with stearic acid, thymol, para-dichlorobenzene and γ isomer of hexachlorocyclohexane (γ HCH) are studied by a modified thaw-melt method. All these systems are seen to form simple eutectic mixtures.

From these data, the latent heats of fusion of PP' DDT and γ HCH are calculated as 6·70 and 5·78 Kcal./mole respectively. Using these values ideal phase diagrams of these systems have been drawn. γ HCH forms an ideal mixture with DDT whereas stearic acid and thymol form non-ideal mixtures. On account of partial evaporation of para-dichlorobenzene from the mixture during experiment, no definite conclusion could be drawn for the same.

349. Studies on the linear rate of Crystallisation of PP' DDT.

S. B. KULKARNI, M. V. KUBER and A. B. BISWAS, Poona.

The linear rate of crystallisation (R) of PP' DDT from supercooled melts has been determined at various temperatures. The effect of a large number of additives on R has been studied. Accordingly these are classified broadly into three groups: (1) talc, bentonite and immiscible wetting agents like Lissapol C, Lissapol LS which do not affect the rate; (2) gammexane and Lissapol NX which retard the rate; and (3) p-dichlorobenzene, naphthalene, paraffin wax, stearic acid and thymol which enhance the rate of crystallisation. The evaluation of the activation energy of crystallisation (E_c) from the Arrehenius relation $R=B \exp. \frac{E_c}{R_T}$ shows that with the increase in the concentration of the additives E_c decreases slowly for system (2) and rapidly for system (3). A qualitative discussion of the results correlating molecular structure with the crystallisation rate has been given.

350. Studies in Potential Filaricides Part I Synthesis of N, N-disubstituted polymethylene diamines as Heterazon analogues.

P. S. WADIA, T. C. ASTHANA, NITYA ANAND and M. L. DHAR, Lucknow.

Synthesis of a number of 1-dialkylamino, piperidine or morpholine, ω-(N-alkyl-N-carbethoxy, diethyl carbamido, and phenylthiocarbamido) ethanes, butanes, pentanes, and hexanes as potential filaricides is reported

The substituted 1:2-diamino ethanes were synthesized by the condensation of dialkylamino, morpholino or piperidino ethyl chloride with primary alkylamines, followed by condensation with ethyl chloroformate, diethyl carbamyl chloride, phenyl isocyate or isothiocyanate. In the condensation of the dialkylamino and piperidino ethyl chloride with primary alkylamines small quantities of the corresponding di-substituted products [N-bis (1-diethylamino or piperidyl ethyl) alkyl amines] were obtained. The substituted hexanes were also synthesised by this general procedure. However, the 1-dialkylamino 4 (or 5) alkylamino butanes (or pentanes) are difficult to synthesise by this method owing to the inherent tendency of their halides to cyclise to the corresponding pyrrolidine or piperidine compounds. These were, therefore, synthesised through the corresponding dialkylamino butyro or valero nitriles, followed by catalytic reduction to the corresponding amines and N-alkylation by reductive alkylation or by acylation followed by lithium aluminium hydride reduction. The carbethoxy and diethyl carbamido derivatives of these 1-dialkylamino-ω alkylamino butanes and pentanes were synthesized by condensation with ethyl chloroformate or diethylcarbamyl chloride.

351. Studies in Potential Filaricides Part II Synthetic studies in substituted imidazolidines and 2-imidazolidinethiones.

P. S. WADIA, NITYA ANAND and M. L. DHAR, Lucknow.

Synthesis of 1-alkyl-3-propyl imidazolidine by condensation of 1-alkylethylenediamine with butyraldehyde is reported. Condensation of 1-alkylethylenediamine with formaldehyde did not give the expected imidazolidine, and polymers were obtained, which have been characterised. In this connection a simple method has been standardized for the synthesis of monoalkylethylene diamines in high yields by the condensation of primary amines with formaldehyde and potassium cyanide in presence of sodium bisulfite, followed by reduction with lithium aluminium hydride. 1-Alkyl-3-acylimidazolidine could not be synthesised, by acylation of alkylimidazolidine, as the ring was found to be unstable to electrophilic attack and is ruptured, resulting in the formation of N-alkyl-N-N'-diacylethylene diamine.

Synthesis of 1-alkyl-3-diethylcarbamyl and phenylcarbamido-2-imidazolidinethiones is also reported.

352. Studies in Potential Filaricides Part III. Synthesis of Homopiperazine analogues of Antifilarial piperazines.

P. S. WADIA and NITYA ANAND, Lucknow.

Synthesis of 1-Methyl-4-diethylcarbamyl and carbethoxy homopiperazines as analogues of antifilarial piperazines is reported. These were prepared from 1-methylhomopiperazine, which was obtained by the lithium aluminium hydride reduction of 1-methyl-5-homopiperazinone. 1-Methyl-5-homopiperazinone was synthesised earlier in a yield of 53%, by Schimdt reaction from 1-methyl-4-piperidone. A study of this step was made and by suitable modification of experimental conditions, it has been possible to increase the yield to 90 per cent.

353. Synthesis of Diaryl thiosulfinates.

M. C. KHOSLA and NITYA ANAND, Lucknow.

Synthesis of some substituted diaryl thiosulfinates as potential antitubercular and antibacterial agents is reported. The earlier methods of synthesis are rather ambiguous and not suitable for the preparation of asymmetric thiosulfinates. The diarylthiosulfinates have now been prepared in good yields by reacting substituted sulfinyl chlorides with sodium thiophenolates in ethereal or dioxane solution, and also by the action of thiophencls on alkylphenyl sulfinates.

354. Studies in Potential Antimycobacterial Agents, Part XIV—Synthesis of p-Alkylamina-p'-amino-methoxy and hydroxy and m,m'-dimethoxy and dihydroxy diphenyl sulfone.

J. K. TANDAN, G. N. VYAS and NITYA ANAND, Lucknow.

The synthesis of some p-alkylamino-p'-amino-*o*, *m*, and *m'*-methoxy and hydroxy and *m*-*m'*-dimethoxy and dihydroxydiphenyl sulfones is reported and the antitubercular activity of some of these compounds is discussed. These were synthesized with a view to study more fully the influence of orientation of the methoxy and hydroxy substituents in diaminodiphenyl sulfones on the antitubercular activity. The reductive alkylation procedure employed earlier for the preparation of *p*-alkylamino-p'-aminodiphenyl sulfones, provided a simple route for the preparation of sulfones bearing methoxy or hydroxy groups in *o* or *m* positions to the -SO$_2$- group.

From this study *p*-ethylamino-*p'*-amino-*o'*-methoxy diphenyl sulfone and *p*-ethylamino-*p*-amino-*m*-hydroxy diphenyl sulfone appear to possess a very favourable therapeutic index, and these two compounds are now being investigated in detail.

355. Studies in Antimetabolites Part I Synthesis of some 4-oxy & 2:4-dioxy-pyrimido (4, 5d) pyrimidines.

S. K. CHATTERJEE and NITYA ANAND, Lucknow.

Some 4-oxy pyrimido (4, 5d) pyrimidines and 2:4-dioxy pyrimido (4, 5d) pyramidines have been synthesised by cyclisation of the respective 2-substituted-4-amino-pyrimidine 5-carboxamides, by treatment with ethyl orthoformate-acetic acid mixture and diethyl carbonate respectively. In this way 4-oxy and 2 :4-dioxypyrimido (5, 4d) pyramidine and 7 (methyl, ethylmercapto and hydroxy) 4-oxy and 2 :4-dioxy pyrimido (5, 4d) pyrimidine have been synthesized. The corresponding 7-amino-derivative of both series were prepared from the respective 7-ethyl mercapto compounds by direct replacement. The chemical behaviour of this ring structure is also discussed.

356. Studies in Potential Antimyocbacterial Agents: Part XV. Synthesis of 2-(o-hydroxyphenyl)-4-alkyl oxazolines.

L. G. SUBRAMANYAM and NITYA ANAND, Lucknow.

Mycobactin has been reported recently as an essential metabolite of certain mycobacteria. As this metabolite contains an 2-(o-hydroxyphenyl)-oxazoline structure, as a part of its molecule, the synthesis of 2-(o-hydroxy phenyl) oxazolines has been started, and the synthesis of 2-(o-hydroxyphenyl) 4-alkyl oxazolines as a first part of this work is reported. These were synthesized by the condensation of methyl salicylate with 1-amino-2-alkanols, followed by ring closure of the amide with thionyl chloride. The 1-amino-2-alkanols were synthesised by condensation of nitromethane with aliphatic aldehydes followed by catalytic reduction.

357. Studies in Potential Amoebicides Part VI. Synthesis of some Bis-phenyl alkylamino pentanes and 1:piperidyl-5-alkyl, phenylalkyl and furyl alkylamino pentanes.

B. PAUL and NITYA ANAND, Lucknow.

Synthesis of 1-(N-ethyl-3 :4-dimethoxy benzylamino)-5-dimethoxyphenylethyl amino, dimethoxybenzylamino, isopropylamino and furfurylamino pentanes, and 1-(N-methyl)dimethoxyphenyl ethyalamino-5-dimethoxybenzylamino pentane as simple analogues of emetine are reported. In addition the corresponding 1-piperidino-5-substituted aminopentanes are also reported, where the 5-substituents are methyl, ethyl, isopropyl, butyl, heptyl, furfuryl, dimethoxybenzyl, p-methoxybenzyl, dimethoxyphenyl ethyl and diethoxy benzyl. The quaternary salts of these compounds would be of interest as hypotensives. The synthesis of these substituted 1 :5-diamino pentanes was carried out by the condensation of chlorobutyro nitrile with the appropriate amine, followed by catalytic reduction of the nitrile to the 1-substituted amino pentyl amines. 5-alkyl, aralkylamine and furfurylamino compound were synthesised by reductive alkylation or acylation followed by reduction.

358. On the antibiotic properties of the constituents of 'Mesua ferrea Linn.

D. P. CHAKRABORTY, M. PURKAYASTHA and P. K. BOSE,
Calcutta.

The four constituents obtained from the seeds of *Mesua ferrea* Linn. (namely mesuol (J. Indian Chem. Soc., 1940, *14*, 277), a 136°-melting crystalline compound, kernel oil and shell oil, were examined for their antibacterial and antifungal properties. It has been found that mesuol and 136°-melting compound possess antibacterial activity against *Staphylococcus aureus*. They are slightly active towards *Bacillus pycyaneous, B. friedlanderi, Escherichia coli, Eberthella typhosa*, and *Vibrio cholerae*. The kernel oil is slightly active against *S. aureus*. The two solid constituents showed nearly 1%activity compared to penicillin G against *S. aureus*, but slightly higher activity than that of allicin. None of the constituents have been found active against the test fungi, *Aspergillus niger, Helminthosporium sativum, Curvularia lunata* and *Alternaria solani.*

INDUSTRIAL AND APPLIED CHEMISTRY

359. Some less known oils for the edible fat industry.

S. BHATTACHARYA, M. K. CHAKERBARTY & M. N. CHAKERBARTY, Calcutta.

In recent years there have been shortages in the availability of fats which can be utilized for the production of vanaspati. Groundnut oil seems to be the only oil which has been utilised for this purpose. In order to relieve the demand on groundnut and to make it available for export as a foreign exchange earner, it is desirable that newer raw materials should be sought. The merits of 16 other less known seed fats *e.g.* Kapolk oil, jute seed oil, Neem oil, Karang oil, safflower oil, Niger seed oil, Tobacco seed oil, Rice bran oil, Nahor oil, Argemon oil, Tea seed oil, Sil oil, Domba oil, Maize oil, Dhopa fat and Sunflower oil have been discussed in this light.

360. The composition and utilisation of the seed fat of Momordica Charantia Linn (variety—Muricata).

A. K. BISWAS, Calcutta.

A detailed study has been made on the fatty acid composition of the seed-fat of Memordica Charantia, Linn (variety-Muricata) which belongs to the Cucurbitaceae family and is conspicious in its rich content of a triene conjugated acid. Analysis of the constituent fatty acids of seeds obtained from 2 different sources has revealed the probable limit of variation of the fatty acid composition :—myristic 1·69—6·19, palmitic 7·96—10·44, stearic 10·63—17·91, arachidic 0·19—2·44, oleic 7·88—9·00 linoleic 7·75—9·30, triene conjugated (as α -eleostearic) 51·70—56·92.

Low temperature crystallisation of the glycerides and subsequent analysis of fractions obtained has enabled to compute the glyceride composition of the seed-fat.

On the basis of the knowledge of glyceride composition and other characteristics of the oil, which suggested possibility of its utilisation as a drying oil, preliminary studies have been made on the varnish making properties of the seed-fat. Detailed work on the evaluation of the merits of the seed-fat as a varnish-constituent is being pursued.

361. The Studies on Assam Blue Oil fraction Part III.

A. N. SAHA, Calcutta.

The mole size distribution curve has been produced by vacuum distillation. The fractions have been analysed according to n-d-M Method. The fractions have been further separated by urea adductation. The adduct and residue both have been analysed by n-d-M method. The fractions whose average molecular weight show that they are not likely to contain hydrocarbon of more than 20 carbon atoms exhibit peculiar behaviour when their adducts are analysed by n-d-M method. Although adducts should not contain any ring structure n-d-M analysis gives rings to the extent of 30% or more. This anomoly is difficult to explain.

362. Thermal polymerization of Dehydrated Castor Oil—influence of the catalyst used for dehydration.

K. K. DOLE and V. R. KESKAR, Poona.

It has been observed that the catalyst used for dehydration of castor oil, influences the nature and rate of thermal polymerization of DCO (dehydrated castor oil). While investigating the influence of the catalyst it was found that the catalyst always remained in the oil, howsoever the DCO was treated for removal of the catalyst. It appears that major portion of the catalyst is retained in the oil in the form of intermediate ester with the hydroxy groups in castor oil. During the study of retention of the catalyst by DCO it was found that 96% of sulphuric acid, 88% of benzene sulphonic acid and 97% of phosphoric acid were retained in the DCO. In the case of sodium bisulphate as catalyst, the salt is found to break up into sodium sulphate and sulphuric acid, the latter being retained by the DCO.

The catalysts, retained in DCO, influenced the heat polymerization of the oil in two ways: (i) some catalysts catalysed intramolecular condensation, while (ii) others catalysed intermolecular polymerization. Benzene sulphonic acid and other substituted sulphonic acids catalysed first type of reaction while sulphuric acid, phosphoric acid and sodium bisulphate favoured intermolecular polymerization. Introduction of -OH group in benzene sulphonic acid, *e.g.*, as in phenol sulphonic acid, completely suppressed intramolecular condensation.

Intramolecular condensation in DCO greatly impaired the film properties of that DCO.

363. Solvent fractionation of Anthraquinone Isomerised linseed oil.

K. K. DOLE and V. A. SARAF, Poona.

Linseed oil is isomerised in presence of anthraquinone as catalyst employing different percentages of it and at temperatures varying between 250° to 280°C. Linseed oil (isomerised) with 16% conjugation (both diene and triene) is obtained. Molecular weights of the isomerised samples range between 850 to 1600 depending upon the temperature of isomerisation. The dried films of isomerised linseed oil however show considerable aftertack. This is due to the existence of molecular species differing considerably in their molecular weights. Isomerised linseed oil is, therefore, subject to solvent fractionation with isopropyl alcohol. Raw isomerised linseed oil is separated into three fractions. Films of the first and second fractions when dried separately give tack free films. Dried films from both fractions exhibit improved water and alkali resistance. Drying time is also reduced. The film from the third fraction shows considerable tack and exhibits poor water and alkali resistance.

364. Studies in Karla Seed Oil.

K. K. DOLE and V. A. SARAF, Poona.

Karla Seed Oil is conjugated drying oil. The major component of its fatty acids contain α-eleostearic acid. Thermal polymerisation of Karla Seed Oil is studied at 200°C and 250°C. The rate of polymerisation is quite rapid at 250°C. Solvent fraction of the raw and polymerised samples is also carried out with isopropanol.

The fatty acids prepared from Karla Seed Oil by the usual saponification method, are resolved into the fractions by the urea adduct method. When the mixed fatty acids are admixed with a saturated alcoholic solution of urea, a crystalline adduct is formed with the more saturated fraction of the acids. Urea removes the more saturated acids through adduct formation while the more unsaturated acids namely, linolic and eleostearic acids concentrate in the raffinate. The method is quite simple and operates at room temperature.

365. The Physico-Chemical properties of the seed fat of Moringaceae family.

K. C. PATEL, R. D. PATEL and S. A. PATEL, Vallabh Vidyanagar.

The seed fats of M.o. (Moringa oleifera) and M.c. (Moringa concanensis) have the following characteristics :—

% oil : M.o. 30 (on kernel), M.c. 29·5 (on kernel); acid value : M.o. 1·777, M.c. 3·6; acetyl value : M.o. 22·9, M.c. 23·0; S.V. : M.o. 182·1, M.c. 182·9; I.V. : M.o. 68·66, M.c. 68·08; unsap. % M.o. 1·769, M.c. 1·279; R.M.V. : M.o. 0·58, M.c. 0·68; polenske no. : M.o. 0·28, M.c. 0·27; Ref. index. at 40°C : M.o. 1·4598, M.c. 1·4860; Saturated acids % : M.o. 22·88, M.c. 24·9; Oleic acid % : M.o. 77·12, M.c. 74·25; Linoleic acid % : M.o. nil, M.c. 0·85.

The saturated acids of M.c. contained My. 1·33; Pm. 5·98; St. 5·24; Arac. 2·97; Behenic 6·09 and Lignoceric 3·29%.

366. Studies on the viscosity of the oil of Moringa Concanensis at different temperatures, Part :—II.

K. C. PATEL, R. D. PATEL and S. A. PATEL, Vallabh Vidyanagar.

The values of kinematic viscosity and densities of mixtures of oil of M. concanensis (Ben oil) in benzene, toluene, xylene, cyclohexane, n-butanol and heptane at different temperatures and concentrations have been determined. It is observed that :—(i) small addition of solvents lowers the viscosity of the oil to appreciable extent. (ii) The variation of viscosity of solvents at higher temperatures is less as compared to that of the oil. (iii) The plot of density-composition shows a linear form. (iv) The formula put forth by Walther expressing the relation between viscosity and temperature for mineral oils, is applicable to the six solvents and their mixtures with oil employed in the present investigation.

367. Studies on the viscosity of the oil of Argemone Mexicana : Part : III.

M. J. DESAI, K. C. PATEL and R. D. PATEL, Vallabh Vidyanagar.

The values of the kinematic viscosity for the different concentrations of mixture of oil of Argemone Mexicana in benzene, toluene, xylene, cyclohexane, n-butanol and heptane have been determined at 30°±0·01°C.

The curves of viscosity-concentration are drawn and found to present a similar type for the mixtures with different solvents. The equation of Walther with modifications is found to express approximately the relation between viscosity and concentration for various mixtures of oil in organic solvents.

368. Effect of Germination on the seed fat of ground nut.

K. C. PATEL, R. D. PATEL and L. F. RABARI, Vallabhvidyanagar.

The effect of germination of the ground nut has been studied. The characteristics of oil samples obtained after germination at intervals of 3 and 5 days have been determined. From the results it can be concluded that :—Yield of Oil decreases, I.V. increases, Acid value increases and Moisture and ash content of seeds are found to increase.

369. Reclamation of Rancid fats.

A. KHAIR, S. BHATTACHARYYA, B. T. R. IYENGAR and
M. M. CHAKRABARTY, Calcutta.

The problem of rancidity have been engaging the attention of oil chemists for a long time. Although elucidation of the causes of rancidity and its prevention to a great extent has been possible in recent years, reclamation of rancid fats have not been studied in any great details.

In the present paper results of the study of this problem has been presented. The method that was used consisted mainly of treating samples of rancid fats with adsorbents like Fullers' earth, activated bentonite, silica gel, activated carbon etc. It was found out that peroxide values of the oils could be reduced to the extent of over 70% by treatment with activated Bentonite at low p.v. ranges on one stage. Successive treatment with bentonite could effect reduction of p.v. upto 98·6%. Stabilisation of rancid oil with antioxidants and synergist have also been studied.

370. Some prospective indigenous sources of drying oils.

B. T. R. IYENGAR and M. M. CHAKRABARTY, Calcutta.

The utilisation of lesser known oils for the surface coating industry has been engaging the attention of chemists and technologists in India for sometime past with regard to performance economy and easy availability. Qualities of drying oils which depend on the fatty acid and glyceride composition can be predicted with modern analytical methods and on this basis the naturally occurring vegetable oils for the paint industry can be classified broadly as containing (i) very largely linolenic acid, (ii) largely linoleic acid, useful for non-yellowing alkyds, (iii) largely elaeostearic or other conjugated diene and triene acids.

(i) For the first category the seed fat of *Bischofia javanica* containing 51% linolenic and 11·8% linoleic acids has been investigated in this laboratory and shows potentialities as a drying oil. Others that fall in this class and which are promising as surface coating oils are, candlenut, stillingia, perilla, rubber seed and hemp seed oils, containing between 25%-70% linolenic and 5%-50% linoleic acids.

(ii) In the second category an important source is tobacco seed oil (Ca. 73% linoleic acid) which can easily and profitably become a very good by-product of the tobacco industry.

(iii) The seed fats of *Trewia nudiflora, Impatiens balsamina, Momordica charantia, Momordica dioica, Tricosanthes cucumerina* and some Indian varieties of *Aleurites montana fordii* have been studied and found to contain 30%-65% conjugated acids. Of these *M. charantia* seed fat containing ca. 48·5% elaeostearic has been investigated in some detail both from the constitutive and technological point of view and has been shown to possess great possibilities as a drying oil which replace tung oil to a large extent.

371. Alcoholysis of oils using Sodium Ethalate as Catalyst.

S K. K. JATKAR and (Miss) M. V. NATEKAR, Poona.

Ethanolysis of cocoanut and safflower oil was studied at different temperatures, using sodium ethalate as catalyst. The reaction rate was followed by refractive index measurements of the oil and ester mixtures at different time intervals. Even with a large excess of alcohol, the reactions do not follow the unimolecular reaction law. In case of cocoanut oil the optimum temperature is 25°C for 0·02N C_2H_5ONa catalyst while in case of safflower oil 35°C is the optimum temperature for 0·02N C_2H_5ONa catalyst.

372. Studies in the pantothenic acid content of Indian cereals.

P. N. JOSHI and Miss S. V. PARADKAR, Poona.

The microbiological assay of pantothenic acid using a. casei A.T.C.C. 7469, and a. Arabinosus 17-5 were critically studied. The influence of lipid material and the causative factors for high blanks was studied. With the use of above methods the estimation of pantothenic acid in Indian cereals was found out. In general cereals appear to be a reasonably good source of pantothenic acid, the amount ranging from 1·0-2·50 mg. per 100 grams of the material. In bengal gram, green gram and rice there exists some material which interferes with the availability of pantothenic acid. Further characterisation of this inhibitory material is being carried out.

373. Cultivation of Lemongrass in Andhra Pradesh.

L. M. SRIVASTAVA, Hyderabad-Deccan.

Lemongrass is extensively used for perfuming soap and cheap scents. Large quantities of the oil are utilised for the isolation of citral used in the preparation of ionone and synthesis of vitamin A. At present there is no systematic cultivation of Lemongrass in Andhra Pradesh and only experimental plots are maintained by the Agricultural Department, while the grass grows wild to a limited extent in one district. As Lemongrass is a hardy plant and grows in almost any kind of soil from rich loam to laterite, attempts were made to cultivate the grass in sandy morram soil to enable the community project scheme to take up the work. Results of cultivation experiments and yield and quality of oil obtained are described.

374. Evaluation of the quality of palmarosa oil for commercial purpose.

L. M. SRIVASTAVA, Hyderabad-Deccan.

India holds an important position with regard to the production and export of palmarosa oil. The oil is produced in the forests by primitive methods and is sold to the stockists in districts from where the stocks move to the towns and finally to the ports like Bombay and Calcutta. At present the transactions are carried out in the districts and towns mainly on the basis of odour and bubble test.

During the course of survey of the production of palmarosa oil in Andhra Pradesh, while examining various oil samples for refractive index, geraniol content and solubility in ethanols of various strengths 55-80% it was observed that the geraniol content could be correlated with the solubility after first sorting out the oils by means of refractive index and colour tests. A simple method of evaluation based on solubility is suggested which gives a fairly accurate idea of the quality of the product.

375. Survey of the production of palmarosa oil in Andhra Pradesh.

L. M. SRIVASTAVA, Hyderabad-Deccan.

Cymbopogon martini (Stapf) commonly called Palmarosa or "Rosha" grass is a tall perennial grass growing wild in many parts of India. The best quality is found in Madhya Pradesh yielding oil of 92-96% geraniol. Andhra Pradesh produces the bulk of the oil exported but the oil has a low geraniol content 60-88%, the geraniol content, odour and composition of oil varying from district to district depending on climate and soil. Survey of the production of oil in the districts of Mahboobnagar, Abilabad, Warangal, Karimnagar, Nalgonda and Medak is described. The geraniol content and physical constants of oil from the various distillation units have been recorded.

376. Cultivation of palmarosa grass in Andhra Pradesh.

L. M. SRIVASTAVA, Hyderabad-Deccan.

India holds an important position with regard to the production of palmarosa oil which is the main source of high quality geraniol employed in all important formulations in perfumery and soap industry. From the commercial point of view the most important regions in which the oil is produced are Madhya Pradesh, Bombay and Andhra Pradesh.

Andhra Pradesh produces the bulk of the oil exported but the oil has a low geraniol content 60-85% and the oil lacks the fine aroma of the Ellichpur quality. At present all the oil distilled is obtained from grass growing wild in the forests and on the borders of fields and no planned cultivation has been attempted so far. Results of experiments on cultivation using genuine seeds from Ellichpur are described. The yield of oil from grass and its geraniol content have been recorded.

377. Safflower seed and oil Part II. Composition and utilisation in surface coatings industry.

N. BHOJRAJ NAIDU, Hyderabad-Deccan.

Safflower oil has been of great economic interest to the surface coating industry, because of its unique composition and properties particularly its resistance to after-yellowing. The morphological character of the seed, composition, heat polymerisation of the oil, varnishes, alkyd resins of 50% oil length combined with urea and melamine resins suitable for baking finishes copolymers of the alkyds with styrene and vinyl-toluene giving products with good gloss, good dry and good colour, and their compatibility in low powered solvents, are reviewed (33 references).

378. Custard apple seed oil modified alkyd resin.

N. BHOJRAJ NAIDU and S. A. SALETORE, Hyderabad-Deccan.

Since the former state of Hyderabad has potentially about 15,000 tons of custard apple seed, the present work was taken up to investigate the possibilities of utilisation of the seed oil in the production of copolymerised alkyds. Glycerol and pentaerythritol alkyds of 40% oil length have been prepared and the results are reported. The resins were found compatible with xylene xylene-toluene, butyl acetate and butyl alcohol mixtures. At a viscosity of H poises at room temperature, their colour in 1 cm. cell was 8·0Y+2·5R, and 4·0Y+1·6R, respectively, thereby showing that the pentaerythritol alkyd is lighter in colour. Their importance as plasticisers in surface coating industry, is stressed.

379. Preparation of safflower modified alkyds of 50% oil length by the alcoholysis process with xylol as the azeotropic solvent.

N. BHOJRAJ NAIDU and S. A. SALETORE, Hyderabad-Deccan.

In continuation of our previous work (Proc. 44th Indian Sci. Cong. Part III Abstracts, 1957, 162) safflower alkyds of 50% oil length using xylol as azeotropic solvent, were prepared and compared with those prepared without solvent. The alkyds were found compatible with xylene, xylene-toluene and butyl-alcohol-butyl acetate mixtures. A 50% solution in xylene gave a viscosity of 1·5 poises at room temperature. The lovibond colour of same seen through 1 cm. cell was 1·2R and 4·0Y. The films on baking at 120°C. for over an hour were hard and had slight after-tack. The film was quite resistant to distilled and tap water, 10 per cent sulphuric acid, mineral and aromatic solvents, but dissolved in one per cent caustic soda solution after immersion for two hours.

380. Studies on some aspects of processing of turmeric.

H. S. R. DESIKACHAR, M. SRINIVASAN and V. SUBRAHMANYAN,
Mysore.

The production of turmeric (*Curcuma longa*) in India is confined mostly to a few selected areas in Madras and Andhra States (Salem and Guntur Districts). There is a large export trade from India worth about a crore of rupees of the product especially to Pakistan and countries in the Middle East. Erode in Coimbatore District is the main centre of the export trade. The two major problems associated with turmeric are its colourisation and its preservation when there is no demand for it. The natural colour of the turmeric tuber is orange internally while it has a dull shade externally. The consumers, especially importers overseas, seem to have developed a taste for and insist on turmeric supplied to them having a pure yellow appearance. So in the past 30 years or so, the merchants have taken to artificial colouring of turmeric to meet this requirement. They have been so far using among other things a composition containing lead chromate for giving the desired shade. With the promulgation of the Prevention of Food Adulteration Act in 1955, the need has arisen to find alternative methods of colouring turmeric. This problem has been investigated at the Central Food Technological Research Institute, Mysore, with success and the process evolved has been demonstrated on a large scale with satisfaction to the merchants at Erode.

Two processes have been developed both of which could be used with advantage. One is the use of acid and bisulphite and the other is the inclusion of an edible blue colour along with turmeric powder which can then be used in the form of an emulsion for imparting yellow tinge to turmeric. Also, when turmeric powder is extracted with alcohol or benzene, the residue left over has a pleasing yellow colour which can also be used for colouring the tubers. Full details of the process will be discussed.

381. Solvent extraction of vegetable oils.

M. B. NARASIMHA and K. S. CHARI, Hyderabad-Deccan.

The advantages and the scope of the Solvent extraction industry in India are discussed, and the need for its growth emphasised. The results of experiments in a pilot plant (Merz) on the extraction of oil from groundnut cake using commercial n-hexane as the solvent are presented. The variables studied are solvent/cake ratio and temperature of extraction, keeping the particle size and time of extraction constant.

The variation of temperature from 45°C to 60°C does not appear to have appreciable effect on the efficiency of extraction for all the ratios of solvent/cake studied. The results indicate that as the ratio is increased from 1 :1 to 1·5 :1, the efficiency of extraction increases from about 80% to about 87%. The residual oil content of the extracted meal also could be brought down from about 1·6% to 1·1% by the increase in ratio of solvent/cake.

382. Fatty Acid Composition of Body and Viscera Oil of Mystus Seenghala.

S. P. PATHAK and S. K. ROY, Varanasi.

The viscera and body oils of Aar Fish (Mystus Seenghala of Bagridae family) were extracted separately. All were obtained from the Ganga at Varanasi in Spring.

Phosphatides were removed from both the lipids by crystallisation from the acetone solution at 0°. The fats were studied by usual saponification and resolution of mixed fatty acids by lithium salt-acetone and lead salt-alcohol methods. The three groups of fatty acids were converted into methyl-esters and fractionated with a modern electrically-heated and packed column. The saponification equivalent and iodine value of each sub-fraction was determined, and therefrom the composition of the fats was calculated according to Hilditch's method.

The component acids of viscera oil are Lauric—0·08%, Myristic 6·83%, Palmitic 13·70%, Stearic 10·38%, Arachidic 5·72%, and Behenic 0·17% as saturated acids, and amongst the unsaturated acids, C_{14}, C_{16}, C_{18}, C_{20}, and C_{22}, are present to the extent of 1·42% (-2H), 14·75% (-2H), 28·65% (-2·6H), 11·63% (-3·5H) and 6·67% (-5·1H) respectively; whereas the composition of the body oil was found to contain Myristic 0·49%, Palmitic 22·27%, Stearic 13·46%, and Arachidic 1·24%, as saturated acids and the unsaturated acids were C_{14}, C_{16}, C_{18} and C_{20} in the proportion of 2·12% (-2H), 7·15% (12H), 41·85% (-1·3H), and 11·42% (-4·1H) respectively. The percentage composition of the acids are expressed in molar percentages excluding nonsaponifiables and the figures in parenthesis indicate the mean unsaturation of the acids.

Present findings of the fatty acid composition of body and viscera oil are in quite agreement with the previous findings of others.

383. Component Fatty Acids of Silondia Fish Oil.

S. P. PATHAK and S. K. ROY, Varanasi.

A sample of Silondia fish (Malabar sea coast, India, sub-order: Siluroidea; Family-Schilbedae; Species-Silonia Silondia) oil was kindly supplied by Sri U. S. Kini, Manager, Government Oil Factory, Kozhikode, Madras.

The oil was studied after the removal of phosphatides and the fat (S.E. 303·40; I.V. 123·5) was saponified. The fatty acids were recovered and resolved into three major fractions according to their unsaturations by the lithium salt-acetone and lead salt-alcohol methods. The three groups of fatty acids were methylated and fractionated with a modern electrically-heated packed column. The saponification equivalent and iodine value of the sub-fractions of each group were determined and therefrom the composition of each group and subsequently that of the whole fat was calculated by Hilditch's method.

The fat contains Myristic 5·07%, Palmitic 23·13%, Stearic 11·20% and Arachidic 0·55% as saturated acids and amongst the unsaturated ones C_{14}, C_{16}, C_{18}, C_{20}, and C_{22}, to the extent of 2·21% (-2H), 12·04% (-2·5H), 33·70% (-4·4H) 11·06% (7·8H) and

0·97% (-9H) respectively. The percentages expressed are molar percentages without unsaponifiables and the figures in the parenthesis represent the mean unsaturations.

The percentage composition of the same species of fresh water type had already been studied in this laboratory. The present finding is quite in agreement with the finding of Lovern (Lovern, J. A., D.S.I.R., Food Investigation Special Report No. *51,* 25, 1942), who brought out the differences in the component fatty acids of marine, fresh water and the intermediate type, i.e., such as are migratory in nature. The present fish oil belongs to the last type.

384. The component glycerides of Camel (Camelus Indicus) depot fat.

S. P. PATHAK and B. N. TRIVEDI, Varanasi.

The Camel depot fat was obtained from a freshly killed Camel of Banaras (U.P.) and is studied for its component glycerides by crystallising the neutral fat with solvents like acetone and ether between temperatures 0° to 12°C.

The component acids in the fat are myristic 4·86%, palmitic 33·87%, stearic 29·06% and tetradecenoic 0·72%, hexadecenoic 5·26% and oleic 26·23% and the component glycerides are about 20·85% of trisaturated (Dipalmito-stearin 12·05% and mono-palmito-di-stearin 8·80%) about 61·67% disaturated-monounsaturated (hexadecenopamito-stearin 8·76%, oleo-palmito-stearin 43·03% and oleo-di-palmitin 9·88%) and about 17·48% monosaturated-diunsaturated (hexadeceno-oleo-palmitin 9·18%, di-oleo-mono-palmitin 2·56% and di-oleo-mono-stearin 5·74%) and no triunsaturated glycerides.

The actual and the computed values for the distribution of acyl groups in the glycerides are :

		Computed	
	Actual	Even	Random
Fully saturated gly.	20·8	3·4	31·2
Disaturated monounsaturated gly. ...	61·7	96·6	44·4
Monosaturated diunsaturated gly. ...	17·5	0	21·1
Triunsaturated gly.	0	0	3·3

The Camel fat favourably corresponds to herbivorous and omnivorous animal fats as regards its fully saturated glyceride contents. Although the actual values do not tally well with the 'random' computed values, still they are very much nearer to the 'random' values but the values are at variance with computed values for 'even' type. The usual explanation of bio-hydrogenation may perhaps be true in this case also.

385. The component acids of Indian shark (carcharias-Tricuspidustus) liver oil.

S. P. PATHAK and B. N. TRIVEDI, Varanasi.

Shark liver oil obtained from the government oil factory Kozhikode, Madras is studied for its component fatty acids, by the modern E.H.P. fractionating column using Lithium salt acetone and Lead salt-alcohol method for separating the fatty acids group.

The chief component acids present in the fat are myristic 5·88%, palmitic 29·38%, stearic 5·35% as well as minor quantities of Arachidic and Behenic amongst saturated ones and amongst unsaturated ones C_{14}, C_{16}, C_{18}, C_{20} and C_{22} to the extent of 2·08, 12·54, 20·05, 17·56 and 6·24% with mean unsaturation as −2·0, −2·0, −2·7, −4·9 and −6·9 respectively.

The fat under study contains about 41% saturated and 59% unsaturated acids and is therefore similar in composition to other shark liver fats (Galeocerdo Rayneri, Carcharious Melanopterus, Pristis Cuspidatus and Galeocerdo Tigrinus) obtained from Indian waters (Arabian sea and Bay of Bengal) studied recently in this laboratory. The saturated acid content of most of these fats, mentioned above lies between 35-43% and the unsaturated ones naturally between 65-57%, this and other fats given above, fall out of the general classification of the marine fats as stated by Lovern in its content of saturated acids which lies between 15-20% only. Tsujimoto had studied some Elasmobranch fishes of Japanese water and classified them into 4 groups. Shark liver oils according to him falls in the 4th group which contain saturated acids upto 50%. Our results only confirm his findings.

386. Study of sugar constituents of mucilage of jute plants by paper chromatography.

G. HALDER, A. K. BANERJEE and M. K. MUKHERJEE, Barrackpore.

The mucilage of leaves of jute plants belonging to the species *Corchorus capsularis* and *C. olitorius* was isolated by extraction with water and precipitated with ethyl alcohol. The crude polysaccharide thus obtained was hydrolysed with (N)H_2SO_4 and with the hydrolysate one-dimensional paper-chromatography was carried out with butanol-pyridine-water. The spots were visualised with aniline-hydrogen-phthalate. The following sugars were obtained--galactose, glucose, arabinose, xylose, ribose, rhamnose and another, possibly a pentose. This last sugar had a R_f-value higher than rhamnose and Rrhamnose value was 1 :1. The mucilages obtained from the two species of jute were found similar in their sugar composition.

387. Essential Oil from the leaves of Murraya koenigii, Spreng.

M. A. SHAIKH and V. A. PATWARDHAN, Sangli.

Murraya koenigii, Spreng. (Sans. Surabhi-nimbu, Mar. Kadhilimb) belongs to the botanical class of Rutaceae. The fresh and air-dried leaves of the tree yield respectively 0·24% and 0·36% of an essential oil. The golden yellow oil gave the following results on analysis: Sp. Gr. at 31·2°C. 0·8628, Refractive Index (Abbe′) at 30°C. 1·492, Specific Rotation $(\alpha)_D 28^\circ$ 70° 6′, Acid V. 7·7, Ester V. 56·96, Acetyl V. 28·0, Boiling range 170°-210°C. (Atm. P. 719 mm.); completely soluble in absolute alcohol, clearly soluble in 8·1 to 8·6 volumes of 70% alcohol. On fractional distillation of the essential oil under 15 mm. pressure, four fractions were collected upto 115°C. From the semicarbazones prepared from two fractions, it is noted that citronellal and citral-a are present in the oil in a fairly large proportion. The detailed examination of the fractions and the residue is in progress.

388. Investigations on Botha grass for the manufacture of Paper and Card board.

G. S. SHENOLIKAR, S. A. SALETORE and S. H. ZAHEER,
Hyderabad-Dn.

Work on Botha grass which grows wild on the borders of Rayalseema, was taken up with a view to find its suitability for the manufacture of paper and card board. Digestion trials with 2% aq. NaOH under different pressures viz. 20, 40, 60 lbs. per sq. in. were carried out and conditions for optimum yields were determined. Yields of bleached pulp and alpha cellulose were also determined.

Proximate analysis for ash, moisture and crude fibre etc. was done. From the low yield of the pulp (digested grass) which is about 25% and the short fibre length, it is tentatively concluded that the grass may not be suitable and economical for industrial exploitation.

Further investigation is in progress.

389. Copolymerization of Vinyl Monomers with Ethylene Part II.

A. S. NAIR and M. S. MUTHANA, Kharagpur.

The effect of temperature, catalyst concentration, pressure and the time of reaction on the composition of the copolymer formed with ethylene and vinyl acetate has been studied. Copolymerisation experiments were also conducted in benzene solution to examine the effect of dilution of the monomers on the rate of reaction. Copolymer compositions were determined and the intrinsic viscosities of the copolymers formed were measured in benzene solution.

390. Microwave Dielectric Measurements of Shellac in 8 m.m. Band.

S. S. SRIVASTAVA, D. D. PURI and P. C. MEHENDRU, New Delhi.

Standing wave technique has been used to measure for the first time dielectric constant and absorption of shellac in the microwave band of 8 m.m. Five grades of indigenous shellac of the highest purity available in the country (supplied by Angles Bros., Calcutta) were used. The materials of names Blonde, Granta, Crown, C. Pure and XL are believed to be free from rosin and the orpiment dye. The dielectric constant and tan δ of the samples at room temperature of 25°C, are of the order of 2·5 and ·02 respectively.

391. Studies on the Polymerisation of Vinyl Acetate in Benzene.

(Mrs.) S. NIGAM and Dr. M. S. MUTHANA, Kharagpur.

The rate of polymerisation of vinyl acetate in benzene solution as well as in the bulk phase has been studied using precipitation method. In solution polymerisation, the rate is found to be of the first order with respect to the monomer concentration, but it is much less in all the concentrations studied than can be accounted for by the dilution of the monomer. The reduction in rate in the benzoyl peroxide initiated polymerisation is considerably higher than in the reaction initiated by the azo catalyst.

392. Studies on the Homogeneous Hydrolysis of Cellulose.

V. P. SHANBHAG, N. R. KAMATH and B. N. GHOSH, Bombay.

With a view to determine the rate constant for the homogeneous hydrolysis of cellulose, a study of the solution of cellulose in 60% perchloric acid, solution of beryllium perchlorate in perchloric acid and solution of zinc chloride in 40% hydrochloric acid has been made. This study reveals that the hydrolysis obeys a first order irreversible consecutive reaction, e.g.

$$\text{Cellulose} \xrightarrow{K_1} \text{glucose} \xrightarrow{K_2} \text{5-hydroxy-methyl-furfural}$$

where K_1 and K_2 are the respective first order rate constants of this reaction and can be easily evaluated by the method developed in this laboratory.

393. Studies on Liquid Phase Synthesis of Ethyl Vinyl Ether from Ethanol and Acetylene under Moderately High Pressures.

S. N. SEN and S. K. BHATTACHARYYA, Kharagpur.

Studies on the liquid phase direct synthesis of ethyl vinyl ether from acetylene and ethanol at moderately high pressures were undertaken to compare this process with the process of vapour phase synthesis at atmospheric pressures. The results of these experiments show that liquid phase pressure vinylation can be safely carried out even at a pressure of 46·3 atmospheres at a reaction temperature of 210°C., using a gas containing 74·9% acetylene and 25·1% nitrogen. Though high rates of conversion have been obtained, Reppe's claim that cent per cent conversion can be obtained has not been substantiated.

Various alkali metals and alkalies, dissolved in alcohol, were used as catalysts. Effect of variation of residence period, reaction temperature, catalyst concentration, and gas cmoposition has been studied, and optimum conditions for conversion of acetylene to ethyl vinyl ether have been found to be: (i) 5% sodium metal in alcohol as a catalyst, (ii) total initial gas pressure of 16 atm. with a gas mixture containing 65·1% acetylene,—the corresponding reaction pressure being 37·9 atm., (iii) three hours' residence period, (iv) 185°C. reaction temperature. Under these conditions, a conversion of 50·9% of acetylene to ethyl vinyl ether was obtained, total acetylene conversion to all the products of reaction being 76·1%. Potassium hydroxide (10%) and potassium metal (5%) gave conversions of 42·1% and 47·1%, respectively. Maximum total conversion of 85·7% acetylene to various products was obtained with potassium hydroxide (5%) at 185°C. in three hours' residence period.

394. "Studies on comparative Volatility of Solvent-Diluent Mixtures from Nitro-Cellulose Lacquer Films" Part 1-A Preliminary Note.

S. M. DAS GUPTA, JAGRAJ SINGH and A. C. MUKHERJEE, Delhi.

Lacquer technologists in India often find difficulties in obtaining the desired results such as smoothness, gloss, hardness, drying time brushability, non-blushing, etc., in a nitro-cellulose lacquer film particularly during summer.

The advent of numerous new artificial resins claiming special properties has further complicated the problem. The success or failure of a nitro-cellulose lacquer depends to a great extent on the evaporation rate of intricate solvent-diluent combination, which has to be used in the lacquer field. In these solvent-diluent combination, each constituent has its proper function in one way or the other. In this preliminary note, the relative volatility of some solvent-diluent combinations has been studied in order to find out in a preliminary way, how far the evaporation of mixture of solvents depends upon the evaporation rate of constituents. It has been found that the evaporation rate of a solvent is modified in admixture, that the evaporation rate of rapidly evaporating solvents fall off considerably during evaporation due to cooling and that although in the beginning the rate of evaporation of the mixture tends towards the highly volatile solvents, but the rate of evaporation gradually tends towards the components of higher evaporation rates.

The above observation may be of some practical value to the lacquer technologists in formulating nitro-cellulose lacquer of desired properties.

395. Fractionation of Shellac.

S. C. SEN GUPTA, Namkum.

Shellac is a complex substance, known to consist of two components, pure resin and soft resin. To study its constitution, American workers fractionated shellac into six fractions adopting a laborious process of extraction with several solvents. The present paper describes a very simple process of fractionation of shellac by progressive polymerisation and precipitation of urea-complex formed by refluxing a mixture of shellac and urea in acetone. Altogether six fractions were obtained, of which five were solid and presumably were derived from the pure resin portion of shellac. The solid fractions, after removal of combined urea by means of boiling water, were soluble in alcohol and alkali and showed difference in their physical and chemical properties suggesting that they might be different individual components.

396. Heavy Creosote for Timber preservation.

D. P. AGRAWAL, B. S. NARAYANA RAO, ANANTH DHARMAPURI,
M. G. KRISHNA and S. HUSAIN ZAHEER, Hyderabad-Dn.

The two types of creosotes for timber preservation specified in the Indian standard Specification No. 218-1952 are based, as in other countries, on the traditional source of High Temperature Carbonisation Tar. The significance of the specifications are discussed briefly here.

The proposed development of Low Temperature Carbonisation Industry in India and the consequent production of large quantities of low temperature tar provide an alternative source for the production of wood preservative creosote. The samples of creosote prepared from Light Tar obtained from the 25 ton/day capacity Lurgi Spuelgas Low Temperature Carbonisation Plant installed at the Regional Research Laboratory, Hyderabad, nearly conform to the ISS No. 218-1952 type one, except for specific gravity. Extensive field tests conducted in America, U.K. and New Zealand have proved that L.T. Tar creosote has bettei fungicidal and anti-termite properties. Based on these tests B.S.S. No. 144-1943 type A_2 and New Zealand Standard Specification No. 401, 1944 for creosote have specified a lower limit of 0·935 for specific gravity to accommodate heavy creosotes from L.T. Tars. Some steps necessary to be taken to introduce creosotes from L.T. Tar in timber preservation industry in India have been suggested.

397. Studies on Emulsion Varnishes: Part I.

M. A. SIVASAMBAN and S. A. SALETORE, Hyderabad-Deccan.

The possibilities of producing stable emulsion varnishes with a view to subsequent production of emulsion paints from same has been investigated in the case of D.C.O.—Ester gum varnishes as a preliminary to the formulation of emulsion surface coatings based on alkyds. The factors influencing stability, have been studied and the properties of the coated films evaluated, and compared with films given by linseed oil varnishes. The optimum proportions of the different constituents for maximum stability have been noted. D.C.O. emulsion varnish has been found to give a tack free quicker drying film than linseed oil emulsion varnishes, with greater water resistance and alkali resistance.

398. Potassium Chloride from Sea Bittern—Part I.

G. T. GADRE, A. V. RAO and H. M. BHAVNAGARY, Bhavnagar.

A process has been worked out by which potassium chloride of 97 to 99 per cent purity has been obtained from the waste bittern of the marine salt industry. The desulphation of the bittern is carried out using commercial calcium chloride. Calcium sulphate is obtained as a byproduct. The bittern which is practically free from sulphate, deposits on concentration a double salt, carnallite, $KCl.MgCl_2.6H_2O$. Potassium chloride is recovered from the double salt by leaching with cold water or by cooling a supersaturated solution of carnallite. The crystals obtained are well defined cubic crystals analysing 97-99 per cent KCl.

399. Benefication of Indian Phosphate ores.

J. BANDOPADHYAY and A. S. BHADURI, Calcutta.

Froth flotation of two apatite ores containing about the same amount of iron but different amount of P_2O_5 and having their origin in Singbhum district, Bihar was carried out in laboratory flotation cell. The effect of feed size, pH, pine oil as frother, oleic acid and palmetic acid as collectors were studied to find out the condition for maximum beneficiation.

For ore No. 1, which contains iron as magnetite, the optimum conditions are as follows

(1) Feed size	−85+120 B.S.S. mesh.
(2) pH	8·5.
(3) Frother	0·42 lbs. pine oil/ton of feed.
(4) Collector	Palmetic acid 4·5 tons/ton of feed.

Maximum of 90% P_2O_5 is recoverable containing about 7·5% iron.

For the second ore the optimum conditions are as follows :

(1) Feed size	−120 mesh.
(2) pH	9·0.
(3) Frother	0·28 lbs/ton of feed.
(4) Collector	Oleic acid 4·35 lbs/ton of feed.

About 97% phosphate is recoverable by this method containing about 8% iron.

For maximum benefication the two ores require slightly different operating conditions.

400. Effect of grinding on plastic and other related properties of a non-plastic China clay.

A. CHAUDHURI, J. SANYAL and D. LAHIRI, Calcutta.

The present investigation was undertaken to study the effect of grinding on particle—Size distribution, base-exchange capacity, flow properties, plasticity, dry strength, dry shrinkage and dry porosity of a non-plastic variety of Indian China Clay. The following properties were measured with eight batches of the clay sample ground in a ball mill for different hours.

(a) base exchange capacity.
(b) flow properties.
(c) plasticity by a modified Endell body tester.
(d) dry shrinkage.
(e) dry strength.
(f) dry porosity.

The specific surfaces of the samples varied from 29650 to 82700 cm.^{2}/gm.

Base exchange capacity of the clay is increased by grinding and there is found a linear relationship between surface area and base exchange capacity. Measurement of flow-properties show that for same concentration of solid under same shearing force viscosity increases as the particles become finer. Plasticity, dry strength and dry shrinkage increase and dry porosity decreases with the increasing specific surface. Excepting for very coarse clay a straight line relationship between plasticity and specific surface is found to exist.

From the point of view of usability of this clay in potteries, it is found that though the plasticity can be increased appreciably by grinding for industrially accessible time, yet the ground clay is very poor witih regard to dry strength which stands in its way to be used industrially.

401. Physical properties of Golconda (Hyderabad) Felspar.

ESHWAR RAJ SAXENA and D. S. DATAR, Hyderabad-Deccan.

The present paper deals with the properties of Golconda felspar used in the study on high temperature reactions of felspar carried out in the laboratory. The complete chemical analysis, petrographic study, minerological composition and softening point of certain reaction mixtures were determined. The felspar is greyish, translucent orthoclase with sp. gravity of 2·563 and hardness of 6 on Moh's scale, showing well marked cleavages under microscope with kaolinization to the extent of 3—5% along with the cleavage.

402. Fullers earth of Rajasthan—Indo-ka-Bala, its occurrence, analysis and bleaching properties. Part II.

S. S. JOSHI, J. DAS and S. A. SALETORE, Hyderabad.

Fullers earth has recently been located near Indo-Ka-Bala, Tehsil Magra. Prospecting has so far revealed the extent of the deposit over an area of 1·4 million square ft. with variable bed thickness and the available quantity is roughly about 3·5 lakh tons. Results of its chemical analysis and colour adsorption properties after activation by sulphuric acid are comparable with other earths found in Rajasthan. Hence there are very good possibilities for industrial exploitation of same for manufacture of activated earths for bleaching of vegetable oils.

403. Studies on Fuller's earths, commercial and laboratory activated ones of composite Hyderabad State.

M. A. HAI, S. S. JOSHI and S. A. SALETORE, Hyderabad-Deccan.

Physical properties such as particle-size by screen analysis, titrable acidity, bulk density, moisture, oil retention, filtrability and percentage colour absorption (with alkali refined groundnut oil) of fuller's earth samples, of Indian manufacture, imported varieties and local earths activated in the laboratory were evaluated. The imported samples appear to possess a higher moisture content, lower bulk density and finer particle size as compared with those of Indian manufacture. Laboratory samples compared favourably with the imported ones.

404. Studies on Whiteware Bodies Part I.

MIR NOMAN KHAN, BALABHEEM RAO, M. A. WAHAB and
D. S. DATAR, Hyderabad-Deccan.

A systematic study of the various raw materials for the porcelain manufacture was undertaken with a view to find out their suitability for high class tableware.

In this paper the possibility of using quartz and feldspar from Andhra Pradesh and Kundara and Singhbhum clays for this purpose is described.

405. Indigenous Ball Clays for Ceramic Industry Part II. X-ray and Differential Thermal Analyses of the clays.

B. RAMA RAO and BALABHEEM RAO, Hyderabad-Dn.

Four ball clays, Cherumuthuseri, Cherukulam, Changanacherry and Pedappakkara from Kerala State were studied for their minerological composition and impurities by X-ray and Differential Thermal Analysis methods. The results of both the methods are in agreement. All clays belong to Kaolin-Fireclay-Halloysite series. Cherumuthuseri and Cherukulam belong to Fireclay type whereas Halloysite and Pedappakkara in between Kaolin-Fireclay. All the clays contain impurities of quartz and alumina hydrates. Alumina hydrate is more in Cherumuthuseri and Cherukulam and less in Pedappakkara and negligible in Changanacherry.

406. Indigenous Ball Clays as raw material for Ceramic Industry Part I, Raw Ball Clays.

BALABHEEM RAO and MIR NOMAN KHAN, Hyderabad-Deccan.

Ball clays from Kerala State were studied for physical and ceramic properties and compared with the imported foreign ball clays. The work on washed ball clays is in progress.

407. Study on Metaphosphate Glass Fibres.

BHUPATI KUMAR BANERJEE, Jadavpur, Calcutta and Jealgora.

The problem of identifying oriented chain molecules in drawn sodium metaphosphate glass fibres has been undertaken with the aid of the magnetic anisotropy method of analysis. The metaphosphate glass fibre exhibits magnetic anisotropy although the anisotropy of metaphosphate glass fibres is found to be small when compared with the boric oxide glass fibres. This observation has been accounted for by the presence ot oriented chain molecules in sodium metaphosphate glass fibres. But on prolonged annealing for the period of twentyfour hours at 375°C, glass fibres exhibit no anisotropy.

408. X-ray Study on some oxide glass fibres.

BHUPATI KUMAR BANERJEE, Jadavpur, Calcutta and Jealgora.

Glass fibres of boric oxide and alkali-boric oxide containing small amount of oxides of Fe and Zr have been studied by the X-ray diffraction method. Evidence is found for the presence of oriented crystallites in boric oxide and low alkali content alkali-boric oxide fibres. It is also observed that the centrosymmetric character of the diffuse bands is not disturbed at all in the X-ray picture of any specimen. Further some interesting observation in the diffraction pattern of the fibre in a few instances during the course of the present study, have been reported.

409. Determination of Ash By Ion-Exchange—Part I—A rapid method of estimation of ash in Molasses.

S. MUKHERJEE, Kanpur.

In the present communication a formula has been deduced for the determination of ash in cane sugar waste molasses by applying ion-exchange technique. A given volume of molasses solution of known Brix was passed through columns containing strong cation exchange resins in the hydrogen form and then washed with water till free from acid. The total quantity of acid liberated was determined by titration against a standard alkali. The formula finally obtained statistically is:

$$Y = 0{\cdot}09072x - 1{\cdot}35.$$

where Y = Sulphated ash on 100 gms. of molasses of 100° Bx.
X = Ml. of normal acid produced per 100 gms. of molasses of 100 Brix.

The results obtained by using the above formula have been found to be fairly accurate.

410. Determination of Ash By Ion-Exchange—Part II—A rapid method of estimation of ash in clarified cane juice.

A. K. CHATTERJEE and S. MUKHERJEE, Kanpur.

In the present set up of sugar industry with modern equipments and methods of sugar manufacture, a knowledge of the ash content of the various juices and molasses is of prime importance for the control of the manufacturing process. It is a problem to the sugar industry to find them out rapidly and regularly within a limited time.

The present investigation deals with the deduction of a formula for the rapid determination of ash in clarified cane juice applying in exchange technique. A given volume of clarified cane juice of a known Brix was passed through columns containing strong cation exchange resins in the hydrogen form and then washed with water till free from acid. The total quantity of acid liberated was determined by titration against a standard alkali solution. From twelve such readings the formula calculated statistically using the equation.

$$Y = Y - A(X - \bar{X})$$

where $a = \dfrac{(X-\bar{X})\,(Y-\bar{Y})}{(X-\bar{X})^2}$ Constant

X = Ml. of normal acid produced per 100 c.c. of clarified juice of 100° Bx.
Y = Sulphated ash on 100 c.c. of juice of 100° Bx.
$\bar{X}$ = Arithmetic means of X series.
$\bar{Y}$ = Arithmetic means of Y series.

on substituting the values of different terms, the formula finally obtained is

$$Y = 0{\cdot}06552X - 1{\cdot}138.$$

The results obtained by using the above formula have been found to be fairly accurate.

411. Determination of Ash By Ion-Exchange Part III—A rapid method of estimation of ash in liquid glucose.

A. K. CHATTERJEE and S. MUKHERJEE, Kanpur.

With a view to deduce a formula for the rapid estimation of ash in liquid glucose applying ion-exchange technique, twelve samples of liquid glucose obtained from M/S. Glucose and Foods Ltd., Bombay, have been analysed for their sulphated ash content by usual gravimetric method as well as by the acidity produced by passing the glucose solution through strong cation exchange resins Duolite C-25 and Amberlite IR-120 in duplicate experiments. A formula has been deduced for calculating the ash by estimating the titrable acidity of the glucose solution by passing through the resins. The formula is as follows :—

$$Y = 0{\cdot}69X - 0{\cdot}1081.$$

where Y = gms. of ash sulphate per 100 ml. of glucose solution of 100° Bx.

X = Ml. of normal acid produced per 100 ml. of glucose solution of 100° Bx.

The above formula has been found to be fairly accurate and the time factor is minimised to a considerable extent as compared to the classical method.

412. A new technique for the measurement of thickness of the Electroplated coating.

H. P. AGARWAL, Bhopal.

From the study of depolarisation Kinetics of platinised electrodes, the idea about the thickness of coating can be had and it would be worth investigating whether this study can also be extended to the other electroplated materials.

413. Relation between degree of hydration and strength of slag-cements.

S. CHATTERJI and D. LAHIRI, Calcutta.

The paper deals with the relation between degree of hydration and the strength developed by mixtures of Portland cement and ground blast furnace slag mixtures at corresponding ages. The results show that for a particular composition, the strength increases with the increase of hydration. But when cements of different compositions were compared as regards their degree of hydration and strength development, it was observed that cements rich in slag developed less hydration for the same strength and this was assumed to be due to the formation of ettringite.

414. Laboratory studies on the air blowing of Low Temperature 'light tar' for wood preservative Creosote production.

D. P. AGRAWAL, B. S. NARAYAN RAO, ANANT N. DHARMAPURI, MOHAMED EHSAN, M. G. KRISHNA and S HUSAIN ZAHEER, Hyderabad-Dn.

Laboratory tests on blowing air through 'light tar', produced in the Lurgi spuelgas pilot Low Temperature Carbonisation plant, installed at the Regional Research Laboratory, Hyderabad, with a view to produce creosote for wood preservation, nearly conforming to I.S.S. No. 218-1952 are described. The effects of temperatures, rates of air blowing and total quantity of air blown, on the yield and properties of the products obtained are indicated. It is found that by blowing air at rates of /¼ to 1 cu. ft./lb./hr. at 200 C for ½ to 2 hours, residues are obtained, which nearly conform to I.S.S. No. 218-1952 type 1, except for specific gravity and Toluene Insolubles. Methods which are likely to reduce the Toluene Insolubles and increase of specific gravity are also indicated.

415. Laboratory studies on the solvent extraction and properties of tar acids from aqueous liquors of low temperature carbonization of coals.

Y. V. SUBBA RAO, M. G. KRISHNA and S. H. ZAHEER, Hyderabad-Dn.

Laboratory experiments on the solvent extraction of ammoniacal liquor produced in the Lurgi Spülgas low temperature carbonization pilot plant at Regional Research Laboratory, Hyderabad, using ether and N-Butyl acetate as solvents are described. From the ether extract, the tar acid, carboxylic and humic acid fractions and neutral oil were estimated by using successive extractions with sodium carbonate, sodium hydroxide and sulphuric acid solutions respectively.

Using N-Butyl acetate as solvent, extraction experiments under carbon dioxide atmosphere were done in a laboratory mixer-settler type unit. From the analysis of feed liquor and raffinate samples for their phenol content by Koppeschaar's excess bromination method, the extraction efficiency was found to be about 97%. The total extracted tar acids expressed as grammes/litre of liquor was 8 83. Catechol and its homologues in the crude tar acids extracted was estimated by lead acetate gravametric method and it comprised of 9·1% of the taracids and 0·8 gramm./litre of liquor.

416. A comparative study of the action of water on 'Active' and 'Pyrophoric' forms of iron.

G. V. L. N. MURTY and T. R. RAMASWAMI, Jamshedpur.

The comparative water reactivities of the two abnormally active forms of iron, viz., active and pyrophoric iron, have been investigated with the help of a specially designed apparatus. The essential feature of the set up is the introduction of water on to a boat, containing the active metal in an atmosphere of hydrogen without effecting any change in the pressure and volume of the system during addition, followed by a measurement of the changes in volume under constant pressure or of pressure under constant volume.

In sharp contrast to the new highly water reactive form of iron, the pyrophoric metal, which is even inflammable in air or oxygen due to vigorous and spontaneous reaction, hardly shows any tendency to react with water at room temperatures (25-30°C).

417. Investigations on 'Active Iron'—Part III—Studies on the reactivity.

G. V. L. N. MUURTY and T. R. RAMASWAMI, Jamshedpur.

Systematic investigations regarding the reactivity of 'active iron' have been carried out with a view to throw light on the following aspects :

(1) The extent to which hydrogen adsorption may account for the observation regarding the gas evolution, and

(2) The chemical nature of the rather unusual reaction with water.

Hydrogen adsorption, even if it occurs, has been shown to be comparatively insignificant to explain the brisk evolution of hydrogen in large quantities.

The rate of reaction with water at room temperatures (25-30°C) and the effect of exposed surface of deposit on gas evolution have been studied in detail which show that the volume of hydrogen evolved is not merely a function of the total quantity of iron but depends largely on that available on the surface and when the limit of saturation is exceeded it is proportional to the area of the deposit.

Evidence has been obtained for the formation of protective oxide coatings on the metal along with the progress of the reaction. The presence of significant quantities of iron in solution and an increase in the pH of water have also been noted.

Thus, the predominantly chemical nature of the active iron-water reaction has been established.

418. Investigation on Active Iron. Part IV—Reaction Mechanism.

G. V. L. N. MUURTY and T. R. RAMASWAMI, Jamshedpur.

A study of the reaction mechanism of the active-iron-water system has been undertaken. The difficulties met with in the direct estimation of the amount of iron taking part in the reaction are briefly indicated and the use of sodium citrate as a suitable expedient by which the reaction is taken to completion when all the iron will be present only in the form of an oxide (or hydroxide) is described. By continuously removing the oxide coating from the active metal surface and estimating the hydrogen evolved per gram of the metal, it has been conclusively shown that the active-iron-water reaction is governed by the mechanism :

$$Fe+2H_2O \rightarrow Fe(OH)_2+H_2.$$

419. Electro-chemical behaviour of Zinc in Alkaline solutions Part I Galvanostatic Technique.

INDRA SANGHI and W. F. K. WYNNE-JONES,
Karaikudi and Newcastle-on-Tyne.

Electro-chemical behaviour of zinc in different concentrations of alkaline solutions has been studied under the conditions of constant-current anodic and cathodic polarisation. Changes of zinc electrode-potential with reference to a Hg/HgO/KOH system have been measured both in KOH and zincate solutions using a luggin capillary and a specially designed cell, current being drawn from an electronic current stabilizer. Time-potential curves have been plotted and it is found that the anodic zinc passivates at a certain stage showing a sudden rise in potential by as much as 3-4 volts. Before the passivation, the main electrode reaction is the formation of Zn^{++}, while after the passivation it changes to gas evolution. No definite relation, as previously suggested by Muller, between the c.d. and the passivation time was found, perhaps due to migration and nonlinear diffusion effects and other reasons discussed in the paper. It has been found that the behaviour of zinc differs in concentrated alkaline solutions (i.e. 0·5 N to 5 N) from that in dilute solutions (0·2 N to 0·01 N), in which case the open circuit reat-potential of zinc is indefinite and may vary by as much as 500-600 mV, and the maximum passivation jump in potential is about 2 volts only. Also the passivation and the decay of current on breaking the circuit are found to be slower than in the case of concentrated solutions. Various colour changes on the zinc electrode, during the polarization are also briefly described.

420. Electrodeposition and dissolution of Zinc in Zincate solution.

INDRA SANGHI and W. F. K. WYNNE-JONES,
Karaikudi and Newcastle-on-Tyne.

The possibility of efficient and reversible deposition and dissolution of zinc in zincate solutions has been studied in this paper. In order to determine the optimum conditions of electrolysis the efficiency of deposition and dissolution are studied as a function of current density and alkali concentration, separately. A record of the morphology of the zinc electrode under different conditions, is also made and reproduced photographically. It has been found that generally the zinc deposited from zincate baths is powdery and non-adherent in nature, and that higher current densities (i.e. 10-50 mA/cm^2) and higher ionic zinc content in the electrolyte (above 2·5 N KOH) show high efficiencies (95% or so). Also, small portion of the deposited zinc is often converted into oxide and hydroxide.

As regards anodic dissolution, it was generally found that during 'active' state of the electrode the efficiency is about 90% while it falls to about 10% if the electrode becomes passivated.

Anodic and cathodic cycling of zinc electrodes was then carried out utilising information obtained above, so as to give a high efficiency for individual anodic and cathodic processes. The electrodes were generally found to lose mass on cycling, probably due to the loose and spongy nature of deposited zinc, some of which falls to the bottom of the cell.

Efforts were made to improve this condition by the use of additives. It was found that the presence of traces of Pb in the alkaline zincate bath greatly improved the nature of zinc-deposition. Radio-tracer techniques, using Thorium B, were finally employed to determine the part played by Pb^{++} in improving the zinc-deposition from zincate baths and it was found that lead is preferably deposited from the electrolyte. The paper also briefly discusses the theoretical aspects of powder deposition with special reference to the case of zinc.

421. Behaviour of Alkaline accumulators in temperature range 0-50°C.

INDRA SANGHI and W. F. K. WYNNE-JONES,
Karaikudi and Newcastle-on-Tyne.

Capacities and coulombic efficiencies of ordinary 'pocket' or 'tube' types of nickel-iron and nickel-cadium alkaline accumulators have been studied in the temperature range 0-50°C. Generally speaking it has been found that capacity and efficiency decrease as the temperature increases, so that only about 30% of the rated capacity is available while working at 50°C.

Input-output and charge-discharge curves at different temperatures both for Ni-Fe and Ni-Cd accumulators have been given and discussed in detail. The charge-discharge curves clearly show that at higher temperatures, not only the capacity but also the energy-efficiency of the accumulators falls. The input-output curve shows a clear point of inflexion which marks the optimum, though not the maximum, of capacity available at different temperatures.

The loss in capacity and efficiency at 50°C cannot be fully recovered on subsequent lowering of the working temperature although partial recovery is gradually achieved after a few weeks working at 0°C.

The capacities and efficiencies in continuous cycle are found to be slightly higher than in interrupted cycles with a time interval of about 15 hours, between charge and discharge.

A change from 6 to 12 hour charge-discharge rate does not show any marked influence or materially affect the capacity in the above temperature range.

422 Anodic Passivation of Zinc in Alkaline solutions.

INDRA SANGHI and T. P. RADHAKRISHNAN, Karaikudi.

In the various recent studies of the anodic behaviour of zinc in alkaline solutions by different authors it was generally found that the passivation times were not very reproducible. The present paper reports interim results of attempts to investigate this problem further and a preliminary account of the experiments perfomed under a variety of conditions to determine the passivation times is given. The irreproductibility of passivation times t^d, observed by previous workers, is ascribed to uncertain convection and other effects arising from the arrangement and geometry of the cell and the electrodes giving rise to non-linear diffusion. Attempts have therefore been made to determine passivation times adjusting the conditions so as to minimise convection effects e.g. by using small shielded electrodes, electrodes covered with sintered glass, or a layer of glass powder etc. so as to provide a better-defined linear diffusion system. It has been found that even under such conditions t_p is not a constant, but actually increases with current density.

The effect of stirring, temperature and presence of zincate ion on passivation times are also being studied.

Whereas a complete quantitative interpretation of the data would need further work, the results obtained definitely support the concept of the passivity being caused by a film, the formation of the latter being controlled by a building up of a high concentration of zincate ions near the electrode.

423. Anodic Polarisation of Cadmium in Alkaline Solutions.

INDRA SANGHI and Y. V. P. RAMACHANDRA ROW, Karaikudi.

Electrochemical behaviour of cadmium in alkaline solutions is of great practical importance from the viewpoint of alkaline accumulators. Also the anodic passivation of metals is of sufficient theoretical interest. Further as not much work on the anodic behaviour of cadmium could be traced in the literature, an attempt to study the same in alkaline solutions has now been made, and initial results reported in this paper. Variation of cadmium anode potential with time during polarisation at fixed current densities in various concentrations of KOH have been measured and results are presented graphically. There appears to be two clear steps in the polarisation curve, although they are more evident in some cases and less in others. The case of cadmium obviously appears to be different from that of zinc and other such metals as the anode and anodic products are not much soluble in the electrolyte (KOH) under similar conditions.

Preliminary study of effect of stirring shows that the stirring hastens the transition time. The graphs of Log I vs. Log T however practically come out to be straight lines, in conformity to the general formulations proposed by Müller. Further work with shielded electrodes providing better controlled diffusion systems is in progress.

424. A study of the Electrodeposition of Iron-zinc Alloys at Rotating Cathode.

K. C. TRIPATHI and H. V. K. UDUPA, Karaikudi.

The paper presents the results of an investigation on iron-zinc alloy plating using a rotating cathode in the zinc sulphate-ferrous sulphate bath recently described by Jepson et al. An experimental arrangement for the alloy deposition on a rotating cathode is described. The influence of r.p.m. of the cathode, the cathodic current density and of the application of interrupted D.C. on the composition of the deposited alloy is reported. Cathode potentials have been measured and the results obtained under different conditions are interpreted in relation to changes in pH occurring in the layer contiguous to the cathode.

425. Potential studies on Passivity to Corrosion induced by pretreatment processes for Metals. Part I: Aluminium.

K. S. RAJAGOPALAN, Karaikudi.

Electrode potential measurements have been widely used in studying corrosion and corrosion inhibition. Such measurements have thrown valuable light on the manner in which addition of various corrosion-inhibitive constituents to the corrosive medium affects the corrosion process, on the mechanism of passivity of alloys and on the inhibitive action of pigments in paints. Similarly, potential-time curves, which indicate the direction of movement of potential with time, have given valuable information on the breakdown and repair of protective films.

Numerous chemical processes have been developed in recent years which improve the resistance of metals to corrosion by the formation of a thin protective oxide, chromate or phosphate film. Their inexpensiveness and simplicity of application have made them very popular in the metal finishing industries. The corrosion resistance or passivity to corrosion induced by these treatments have so far been studied only by means of direct tests such as accelerated corrosion tests and field tests and no potential studies, which alone can give an insight into the manner in which the passivation has taken place and of the breakdown and repair of the protective film in different corrosive environments, have so far been carried out. The author presents in this paper the results he has obtained with aluminium and as pointed out in the paper work on other metals like zinc, steel and tinplate is in progress.

The author has observed that aluminium when passivated by various chemical oxidation processes gives a more negative initial potential as compared to untreated metal. The cathodic polarisation curve of the treated metal was also found to be much steeper than that of untreated metal. The local cell theory of corrosion as elaborated by Mears in regard to the mechanism of passivity and inhibition requires that greater polarisation of the local cathode without any corresponding change in the local anode should shift the overall potential in a negative direction. The observations made with regard to aluminium appear to conform to this concept of metal potential.

426. Lead Plating from the Pyrophosphate Bath.

(Miss) VASANTA SREE and T. L. RAMA CHAR, Bangalore.

The pyrophosphate bath has been developed for the electrodeposition of lead. The optimum conditions have been established for satisfactory deposition. With a low lead content, the plating solution can be worked up to a current density of 5 amp/dm^2. Cathode and anode potentials have been measured, and anode behaviour studied.

427. Nickel-zinc Alloy Plating from the Pyrophosphate Bath.

S. K. PANIKKAR and T. L. RAMA CHAR, Bangalore.

A new type of bath has been used for the plating of nickel-zinc alloys. It consists of nickel chloride, zinc pyrophosphate and potassium pyrophosphate. It is possible to obtain alloys with a wide composition range by varying the experimental conditions. Cathode efficiency and potential measurements have been made.

428. Action of Carbon Monoxide on Glycol at High Pressures.

G. K. NARAYANA REDDY and M. R. A. RAO, Bangalore.

In a study of the reactions between carbon monoxide and polyhydric alcohols under high pressure, the system glycol-carbonmonoxide has been investigated employing nickel iodide catalysts under a variety of experimental conditions. In presence of nickel iodide catalyst supported on kieselguhr it has been noticed that the yield is only 2 to 3 per cent. When nickel iodide is dissolved in the glycol the percentage conversion of the glycol into the corresponding acid is only slightly increased. When the catalyst is associated with potassium carbonate to neutralise the acid formed it has been noticed that the yield is increased to 7 to 10 per cent. This yield is obtained when the reaction mixture is maintained at a temperature of 300°C and a pressure of 5,000 psi for a period of 5 hours.

429. Oxidation—Reduction Reactions in Steam-iron Process.

A. R. GHOSH and A. N. ROY, Kharagpur.

The mechanism of reduction in hydrogen and of oxidation of reduced haematite ore preparations by steam have been investigated in view of its technical importance in the steam-iron process. The ore containing about 97·5% Fe_2O_3, was finely pulverised and pelleted with binders such as cement, sodium silicate, CaO, etc. To increase the porosity a foaming agent (Igal No. I, I.C.I.) was incorporated in some of the preparations.

The rate of reduction was studied with H_2 in the temperature range of 400° to 550°C employing a dynamical system. The reducibility of haematite was markedly enhanced when a foaming agent was incorporated. This is attributed to the increase in porosity of the material. However, the improvement due to increased porosity progressively diminished with the rise of reduction temperature. At higher temperatures the H_2 could react by rapid diffusion through the lattice of the freshly reduced iron and therefore, the porosity factor became less significant. At 400°C an autocatalytic mechanism involving formation of Fe_3O_4, the stable phase at this temperature, has been suggested. In the initial stage, the reduction process was found to follow a monomolecular rate. The apparent activation energies determined for the foam and foamless material were 9,700 and 58,000 cals/mole respectively.

Oxidation of partially and completely reduced ore preparation with steam was investigated in the temperature range of 550°-950°C. It was observed that the rate of oxidation decreased with the rise of temperature beyond 625°C due to sintering which became quite marked in the region of 825°-950C.

Materials made porous by foaming agent showed enhanced activity; the effect decreased with rise in temperature as was observed in the case of reduction process. At 550°C an autocatalytic mechanism was detected. At this temperature the reaction, $3Fe+4H_2O \rightleftharpoons Fe_3O_4+4H_2$ occurred while at higher temperatures, $Fe+H_2O \rightleftharpoons FeO+H_2$ reaction took place.

The rate of oxidation with the partially reduced material (68% Fe) was much greater compared with the completely reduced one. Presumably the latter being pyrophoric, was rapidly covered with a continuous oxide film which was more resistant to the diffusion of steam through it.

430. Corrosion of Iron Wire in some acids and salt solutions.

B. P. GYANI and R. MISRA, Patna.

This work is in continuation of the one reported before (These Abstracts, 1954, p. 84; 1956, p. 153). Corrosive actions of a number of solutions on pure iron wire have been studied over a period of two years. Sodium carbonate when at least N/50 and sodium nitrite and ammonia at even lower concentrations (N/1000) appear to inhibit corrosion completely. N/100 solutions of sodium acetate, propionate, succinate, benzoate and salicylate produced only temporary inhibition extending to six or seven months. These limitations may be due to destruction of the organic materials. The rates of corrosion in N/100 sulphuric, hydrochloric, nitric, oxalic and citric acids at room temperature and N/10 to N/100 acetic acids under different conditions were also studied. The apparent energy of activation for corrosion for N/10 solutions (12-31°) was found to be about 10,800 cal. per g. atom. The products of corrosion are at least physically different at different concentrations and temperatures.

431. Production of Hydrogen sulphide from sulphates.

(Miss) RAZIA OSMANI and D. S. DATAR, Hyderabad-Dn.

The production of hydrogen sulphide from magnesium sulphate, barium sulphate and sodium sulphate by passing steam over heated mixture of sulphate and coke at 800°—900° was studied. The recovery of sulphur as hydrogen sulphide is complete. In case of sodium sulphate a valuable byproduct like sodium carbonate is obtained.

432. Hydrogen peroxide from hydrazo benzene by autoxidation.

K. N. MOORTHY and D. S. DATAR, Hyderabad-Dn.

The advantages of the autoxidation process for the manufacture of hydrogen peroxide are described. The process uses less expensive plant, consumes less electricity and produces concentrated hydrogen peroxide. In this paper hydrogen peroxide is prepared by successive reduction and oxidation of azo benzene in ethyl alcohol and benzene solutions.

433. Formation of Hydrazine under the influence of Electric discharge.

A. JOGARAO and B. S. R. SASTRI, Karaikudi.

Recognition of hydrazine as an important industrial chemical has come up only recently, chiefly in connection with development of new jet and rocket fuels. Preparation of hydrazine by Raschig's method using ammonia and urea as starting materials is no doubt available but purification of the resulting Raschig's liquor, which is essential, is rather cumbresome. In view of possibilities indicated in literature, studies of formation of hydrazine from ammonia under glow discharge were undertaken by the authors.

Using Siemen's tube the gas was subjected to 3000-15000 volts (r.m.s.) varying the rate of flow in the range 75-450 m.gr. per minute. The best yield, 0-75% of hydrazine, was obtained at 75 m.gr. per minute and 3750 volts, compared to 1-2% Hydrazine in the Raschig's liquor, as it is formed.

When the gas was subjected to intermittent semi-wave discharge in Geissler-type tubes the concentration improved from 0·1 to 0·18% of hydrazine and the electric power yield was double that obtained under a.c. for a gas-flow of 120 m.gr. per minute at 15 cm. Hg., and 2100 v. Instability of hydrazine under the conditions obtaining in the discharge tube is a serious handicap and studies at very low temperatures favourable for the existence of free radicals appear to be of promise.

434. m-Dinitrobenzene as a Vapour Phase Inhibitor.

K. S. RAJAGOPALAN, Karaikudi.

A new material known as vapour phase inhibitor has been introduced in recent years in the field of corrosion preventives for ferrous stores. Vapour phase inhibitors are, as their name implies, substances which volatilise into the atmosphere surrounding the metal to be protected and make this atmosphere non-corrosive. For their use, direct application of the vapour phase inhibitor on the metal to be protected is not necessary as in the case of temporary preservatives based on petroleum products and hence the need for removal of the inhibitor also does not exist. As the inhibitor acts in its vapour form, it can reach any part of a complicated equipment and the need for dismantling of the equipment, which is inevitable in the case of the petroleum type of preservatives referred to above, also does not exist. The earliest work relating to development of such protectives dates back to war-time work of the U.S. Naval Research Laboratory. Since then a succession of very useful vapour phase inhibitors have been quickly developed. The author in collaboration with others had earlier studied the behaviour of a number of chemicals from this point of view and that work is being reported elsewhere. In the course of that investigation it was noted that m-dinitro benzene did not give protection to steel under conditions where continuous condensation of moisture on the metal surface took place but there were indications that it could give better results at lower humidities. The better performance of the chemical under these conditions is reported in this paper.

435. One-step Catalytic Synthesis of Butadiene from Ethanol in presence of Magnesia and Alumina Catalysts.

N. GANGULY and S. K. BHATTACHARYYA, Kharagpur.

The suitability of magnesia and alumina catalysts for use in the Russian one-step process for the synthesis of butadiene from ethanol has been investigated in the temperature range 350°-425°C., and maximum process conversions of 36% with magnesia and 48% with alumina have been obtained. Other products, most of which are formed in negligible quantities, are aldehydes, ketones, higher alcohols, ethers, and saturated and unsaturated hydrocarbons. The method of preparation, best suited to produce maximum catalytic activity, has been determined as the one involving precipitation by ammonium carbonate, drying at 110°C. for 24 hours, and activation at 375°C. for 6 hours in nitrogen atmosphere.

For magnesia as well as alumina, the optimum temperature for maximum butadiene yield is 400°C.; above and below this temperature, the yield of butadiene falls, though the yield of unsaturated hydrocarbons, on using alumina catalyst, shows a progressive rise even above this temperature. The optimum rate at which the vaporised liquid should be passed at 400°C. over the heated catalyst is 0·9375 cc/hr/gm. of magnesia catalyst and 1·875 cc/hr/gm. of alumina catalyst. Differential thermal analytical studies on these catalysts have been conducted to correlate their activity with their thermal behaviour.

Further investigations are in progress.

436. High Pressure Synthesis of Lactic Acid from Acetaldehyde, Carbon Monoxide and Water.

R. ATCHYUTA RAO and S. K. BHATTACHARYYA, Kharagpur.

The high pressure synthesis of lactic acid from acetaldehyde, carbon monoxide and water in the temperature range of 100°-300°C. and the pressure range of

2500-7700 psi. has been carried out, using iodides of nickel, cobalt and iron as catalysts. Comparative studies on the activity of catalysts indicate that the order of activity is iodide>chloride>bromide. Nickel catalysts are found to be superior to cobalt and iron catalysts. Silica, gel, as a support, is more efficient than kieselguhr and other supports.

Investigations into the optimum operating conditions to be used for iodide catalysts show that, at a temperature of about 230°C., maximum conversion of acetaldehyde to lactic acid takes place. Pressures upto 6000 psi. are both necessary and sufficient to effect reasonable conversions. Using the static technique, a period of three hours is required to complete the bulk of the reaction.

437. High Pressure Synthesis of Ethyl Propionate from Ethylene, Carbon Monoxide and Ethanol.

S. N. NAG and S. K. BHATTACHARYYA, Kharagpur.

High pressure synthesis of ethyl propionate from ethylene, carbon monoxide and ethanol has been carried out at 4500—5500 pounds per square inch pressure, using nickel iodide—silica gel and cobalt iodide—silica gel catalysts of metal : silica ratio 50 : 50, and a mixture of ethylene and carbon monoxide in equimolar proportions. A temperature range of 200°-250° C. is found suitable for the reaction. Nickel iodide is superior to cobalt iodide in its catalytic activity for the synthesis reaction as well as for the side reaction involving polymerisation of ethylene. The latter reaction produces liquid polymers which are unsaturated in character and distil in the temperature range 70°-150°C. The extent of polymerisation is not considerable below 200°C.

At 210°C. and 5200 psi. reaction pressure, use of nickel iodide—silica gel catalyst produces a product containing 27·3% ethyl propionate, 15·4% propionic acid, and 26·0% liquid hydrocarbons.

438. High Pressure Syntheses of Glycollic Acid and its Methyl and Ethyl Esters from Formaldehyde.

DHARAM VIR and S. K. BHATTACHARYYA, Kharagpur.

A comprehensive study, involving 63 catalyst compositions of nickel, cobalt and iron, has been made at 140°-275° and 1500-8700 psi. on the high pressure catalytic syntheses of glycollic acid, methyl glycollate and ethyl glycollate by the reaction of formaldehyde and carbon monoxide with water, methanol, and ethanol, respectively. Maximum process conversions in the static system are 45% to glycollic acid, 25% to methyl glycollate and 23% to ethyl glycollate in a period of 5½ hours. The order of catalytic activity is nickel>cobalt>iron, and iodide>bromide>chloride> reduced metal. The effectiveness of the catalyst support is silica gel>kieselguhr> pumice>kaolin>charcoal>unsupported catalyst. Cuprous iodide, magnesia and thoria, singly or jointly, and excess iodine exercise a deleterious effect on the catalytic activity. Optimum operating factors, pertaining to pressure, temperature, residence period, catalyst life, gas purity presence of methanol, reactor volume, use of catalyst grid, reactant volume, formaldehyde : water ratio, catalyst volume and low temperature release, have been investigated for iodide catalysts in all syntheses and conditions for maximum yield have been established. There is a decrease in catalytic activity for the ester syntheses after the first run, but the activity can be restored by treating the spent catalyst samples with water or by releasing the product at low temperatures.

A formulation of the reaction mechanism and of catalyst action, based on the syntheses studies, catalytic pyrolysis of individual reactants and differential thermal analytical investigations on iodide catalysts, has been suggested by us.

439. High Pressure Syntheses of Adipic Acid and Delta-valerolactone from Tetrahydrofuran, Carbon Monoxide and Water.

S. K. BHATTACHARYYA and D. K. NANDI, Kharagpur.

A comprehensive study has been made on the high pressure catalytic synthesis of adipic acid from tetrahydrofuran, carbon monoxide and water. A number of catalyst compositions containing nickel, cobalt and iron have been investigated Studies on the comparative activity of catalysts indicate that among the halides, which are superior to the reduced metals, the iodides are superior to the bromides or chlorides. Further, activity varies in the order Nickel>Cobalt>Iron. Silica gel support is found to be superior to kieselguhr, pumice or kaolin, unsupported catalysts produce low yields of adipic acid.

Use of iodide-silica gel catalysts for intensive investigations has indicated the following optimum conditions: (*i*) a temperature of 200°C., (*ii*) a pressure of about 4500 psi., (*iii*) a catalyst volume of 15 c.c., (*iv*) a residence period of 3 hours (*v*) tetrahydrofuran : water ratio of 1 : 1. There is no marked fall in activity on re-use of catalyst samples.

The synthesis of adipic acid from tetrahydrofuran, carbon monoxide and water at high pressure may involve a two-stage process, the first being the reaction of tetrahydrofuran with carbon monoxide to give delta-valerolactone which, in the second step, reacts with water to produce adipic acid. Data supporting this mechanism are, however, completely lacking and hence a detailed investigation has been carried out on the synthesis of delta-valerolactone from tetrahydrofuran and carbon monoxide at high pressure in presence of nickel, cobalt and iron iodides found to be most satisfactory for the synthesis of adipic acid. Results obtained appear to be highly significant and important and support the hypothesis that adipic acid is formed from tetrahydrofuran by the two stage process.

440. Recovery of Crude Motor Spirit (CMS) from low temperature Carbonisation Gases of some Indian Coals.

S. A. QADER, D. K. RAO, M. G. KRISHNA and S. HUSAIN ZAHEER,
Hyderabad Dn.

Crude motor spirit (CMS) or Benzole, consisting of light hydrocarbons usually boiling upto 180°C, is an important byproduct of Carbonisation Industry and can be recovered from the carbonisation gases. The proportion of CMS depends mainly on the temperature of carbonisation and the type of coal carbonised. Coke-oven gas contains about 1% by vol. of Benzole and it contributes to about 5% of the heating value of the gas. At present, benzole is recovered in India to the extent of only about 1·8 m. gallons/annum though the installed capacity of plants is about 2·4 m. gallons. Complete recovery of benzole from the present and future carbonisation plants will add substantially to the indigenous resources of motor spirit.

Laboratory scale experiments were conducted on the recovery of CMS from circulation gases from the Lurgi Spuelgas Low Temperature Carbonisation Pilot Plant, operated at the Regional Research Laboratory, Hyderabad. Employing Active Carbon absorption and wash-oil scrubbing methods, it was found that 1·5 to 2 gals. of CMS could be recovered per ton of Kothagudem coal carbonised at 650°C and about 2·5 to 3 gals. per ton of Upper-Khajora coal. The absorption method gave better results.

441. Prevention of Caking of Ammonium nitrate Part I. Hygroscopicity of silt Ammonium nitrate coated with conditioners.

ESHWAR RAJ SAXENA and D. S. DATAR, Hyderabad-Deccan.

A study was made on the hygroscopicity of ammonium nitrate at different temperatures and humidities, using river silt as a diluent and several coating agents. The coating agents used are arranged in order of their decreasing efficiency as follows :—

Bones, silt, talc, mica, steam bone and tricalcium phosphate.

The bone or silt coated sample was found to be better than the foreign commercial samples.

442. Prevention of caking of ammonium nitrate Part II Comparative study on the effect of different diluents and coating agents.

ESHWAR RAJ SAXENA and D. S. DATTAR, Hyderabad-Deccan 9.

The present paper describes the effect of using calcium carbonate and silt as diluents and bone and silt as coating agents on hygroscopicity and caking of ammonium nitrate fertilizer. It is observed that bone has better covering power than silt and that bone coated silt ammonium nitrate has less caking tendency than even some foreign commercial samples.

443. Dephosphorisation of Alloys in Hydrogen.

B. CHATTERJEE and S. BHATTACHARYA, Sibpur.

In continuation of our work on the dephosphorisation of alloys under gaseous anneal, studies have been made of the removal or otherwise of phosphorous from powdered samples (40 mesh) prepared from an iron-phosphorous alloy containing 2·4 per cent phosphorous on heating at 1000°C for varying periods of time in flowing hydrogen containing 1·20 per cent by volume of moisture. The iron-phosphorous alloy was prepared by melting together wrought iron and the necessary amount of ferro-phosphorous in an induction furnace. No dephosphorisation could be observed even when the sample was heated with moist hydrogen for 60 hours under the conditions of the experiment. This result is of interest in that it has been observed that moist hydrogen at 1000°C can bring about dephosphorisation of powdered samples of cast iron, the phosphorous contents of which are above 0·90 per cent. The marked influence of the composition of the alloys on the dephosphorisation process is thus indicated. Further work on this issue is in progress.

444. Coal gas as a substitute for Synthesis gas in the Fischer-Tropsch Synthesis.

G. C. BASAK and N. C. NIYOGI, B. E. College, Howrah.

The work on the Fischer—Tropsch synthesis was extended to a study of the reactions using coal gas as a substitute for the usual synthesis gas consisting of CO and H_2 in the ratio of 1 :2. Previous work by the authors (as reported in earlier papers) having demonstrated better activity of cobalt catalyst over iron catalyst, work was confined to cobalt catalyst alone (40 cO; 8 MgO : 5 ThO_2 : 80 Kieselguhr). The oxygen of coal gas presented major problem which defied all attempts at removal by conventional methods. A new method which consisted of passing the coal gas through an electric furnace containing copper turnings heated to 250°C was developed. The method, however, suffered from the disadvantage that a part of H_2 of coal gas was lost in reacting with O_2 which was removed as water. The effects of temperature within a range of 180°=220°C on the efficiences of the reactions relating to the formation of different products were studied at an interval of 10°C. The results showed gradual increase of p.c. efficiencies with a rise of temp., the peaks were reached at 200°C after which there was a gradual decline. The over-all efficiency increased gradually from 28·5 p.c. at 180°C, reached the maximum of 51·0 p.c. at 210°C. Similar trends were observed with regard to higher hydrocarbons other than CH_4-formation efficiencies and yields of products including and excluding CH_4. Such low figures are attributed to very low percentages of CO and H_2 in the O_2-free coal gas prepared in the process. Further work to study the effects of pressure on the progress of the reaction is continuing.

445. Depolarisation Kinetics as a means to the study of porosity and nature of coating.

H. P. AGARWAL, Bhopal.

Whether the electrode (an object) has been gold plated from the cynide bath or chloride bath can be easily distinguished by the study of depolarisation Kinetics. It has further been helpful in differentiating an uniformly coated surface from the one unevenly coated or having porosity, hence it would be very interesting and useful to extend this technique further for the above investigations.

446. Application of nonaqueous titration technique to studies on fatliquors.

MISS P. V. RAJALAKSHMI, D. RAMASWAMY,
& Y. NAYUDAMMA, Madras.

Fatliquors are produced by the sulphation of vegetable and marine oils. They contain a mixture of acids or salts of sulphuric acid $SO_4<$, sulphonic acid SO_3H-, acid sulphate-OSO_3H and fatty acid—COOH. Non-aqueous system offers itself as a valuable tool for the differential estimations of these acids or salts. The method consists in removing the inorganic acid or salt $>SO_4$ by extraction with an organic solvent like amyl alcohol or n-butyl alcohol and titrating the extracted portion and the original fatliquor in ethylene glycol-n-butylalcohol-benzene medium with perchloric acid in dioxan as titrant in presence and absence of Mercuric acetate. Conclusive end points are obtained and the method if exploited may considerably simplify the procedure for determination of these constituents in fatliquors.

447. Effect of Addition of Aluminium chloride on the Ultra-violet absorption spectra of Tanning Materials:

D. RAMASWAMY & Y. NAYUDAMMA, Madras.

Aluminium chloride has been successfully used for distinguishing the ortho-dihydroxy phenolic groups by employing it as a complexing agent which produces a shift in the maximum of the u-v. absorption curve. Since tanning materials contain polyphenolic groups in different positions, the effect of addition of aluminium chloride on the u-v. spectra of an number of purified tanstuffs was investigated. It has been found that the catechol tanstuffs like avaram and wattle do not cause any shift in the peak nor any change in the intensity suggesting that orthodihydroxy phenolic groups may not be present in these types of tanning materials. With pyrogallol type tanning materials like Myrob and Divi-divi, there is a shift of 35-40μ/4 in the peak which is of the same order if 2 hydroxyl groups are present in the ortho position. With a few other pyrogallol type tanstuffs like Dhawa and chestnut an inflexion alone is perceived indicating the possibility of formation of similar complexes with aluminium chloride. Thus the absorption spectra with added aluminium chloride to the tanning materials throws considerable light on the positions occupied by the phenolic groups.

448. Studies on Synergism in Antifoaming Agents.

N. A. RAMAIAH and S. K. D. AGARWAL, Kanpur.

The phenomenon of synergism referring to an increase in the individual efficiency of two antifoaming agents when mixed together, was discussed. This was investigated in Turkey red oil and cerfak solution, using 20 Bx molasses solution inoculated with yeast. 3 per cent cerfak solution mixed with the oil has its maximum antifoaming capacity.

449. Determination of Thermodynamic Characteristics of Caramelisation of Sugars.

N. A. RAMAIAH and S. K. D. AGARWAL, Kanpur.

Kinetics of caramelisation of sugars in alkaline solutions were studied spectrophotometrically. The reaction appeared to be first order in nature. The corresponding constant k varied with temperature T in accord with the following equation :

$$A/T+B+CT=-\log k$$

where A, B and C are constants. Employing this equation, the thermodynamic quantities viz. free energy (ΔF), entropy (ΔS), heat content (ΔH) and heat capacity (ΔCp) were calculated. These are as follows for calamelisation of glucose at 60°C :

$$\Delta F = 9628 \text{ cal.}$$
$$\Delta S = 118{\cdot}7$$
$$\Delta H = 49{,}168$$
$$\Delta Cp = -76{\cdot}29$$

450. Studies on the Production of Furfural from Bagasse.

S. L. PHANSALAKAR, S. NATH and S. C. JOLLY, Kanpur.

The use of furfural as a starting material for the production of number of industrially important products, like nylons, plastics was reviewed. The production of furfural from bagasse, which is obtained in India in several lakh tons per year was investigated by subjecting bagasse to the action of mineral acids and also to the action of water at high temperature and pressure. Detailed investigation shows that a maximum yield of furfural of 17% was obtained.

451. Manufacture of Methyl Bromide.

S. D. MEHTA, Mithapur.

There is a growing demand for this chemical in the country for fumigation of tightly packed goods. Methyl bromide is toxic and, therefore required to be handled with utmost care. Dosages of about 1 lb. per 1000 cu. ft. (16 mg. per litre) for 8 hours or more are quite effective.

Methyl bromide could be made by reacting bromine with methane or hydrobromic acid with methanol. But little is known about details of its preparation either in the laboratory or on a manufacturing scale. All the basic chemicals such as sulphuric acid, methanol and sodium bromide are now produced in India. The paper is, therefore, an attempt at making this needed fumigant and describes experiments carried out in the Research laboratories, Tata Chemicals Ltd., Mithapur.

452. Study of the absorption of oxygen and the autoxidation of phenols and vegetable tannings by polarographic technique.

(Miss) A. NAGASIROMANI, D. RAMASWAMY and Y. NAYUDAMMA,
Madras.

The polarographic behaviours of the autoxidised phenols and vegetable tanning materials were studied in ammonical medium at pH 9·2. They were found to give cathodic waves with E1/2s ranging from −0·9 to −0 94 volts The waves are probably formed due to the presence of hydrogen peroxide which is one of the products of autoxidation. The E1/2s of the hydrogen peroxide in the same buffer check with the values obtained by the polyphenols and tanstuffs. The quantity of H_2O_2 found calculated from the values of diffusion current could be used for the determination of oxygen absorbed by the polyphenols using hydrogen peroxide standard curve. Further investigations on the cathodic waves showed that the hydrogen peroxide produced on account of autoxidation is in a state of equilibrium with the reactants and the products.

453. Studies on Air Activation of Cokes. I. Active Carbon from Tandur Coke.

T. L. NARASIMHA RAO and D. S. DATAR, Hyderabad-Deccan.

Active carbon prepared by air activation of coke obtained by the low temperature carbonisation of Tandur coal was used for the refining of groundnut oil.

454. Wear of Metallic surfaces by Abrasive Suspension in Water.

S. RAMACHANDRAN and S. R. RAJAGOPALAN, Bombay.

The Central Railway desired a remedy for the rapid wear of injector delivery ram cones used in steam locomotives. It is generally known that a rough surface of a soft metal may contribute to wear. The possibility of minimising such a wear by providing a smooth chromium plated surface was examined with brass specimens unplated, and plated with chromium. Experiments show that such a treatment leads to the desired result. This has been confirmed by actual service tests. An explanation of the probable mechanism of wear is suggested.

455. A short note on Electron-Microscopic Study of Anodic layers on tin in 0.1 N. NaOH.

INDRA SANGHI, Karaikudi.

As no definite studies of the micro-structure of anodically produced oxide layers on tin in alkaline solutions have so far been reported in literature, a preliminary attempts was made, for the first time, to explore their structure by electron-microscopic techniques. Electron-diffraction has also been tried but was not found very useful and successful as the layers were mostly amorphous in nature. Even with electron-microscopic techniques the reproducibility of micro-structure was found to be poor due to the various reasons discussed in the paper, which is exploratory in nature. Various experimental difficulties in the stripping isolation and purification of the anodic layers and in preparing proper specimens for examination by transmission microscopy have been discussed and methods suggested to overcome the same. Shadowing and replica techniques were also employed and some evidence collected showing the existence of several different layer structures dependent on the conditions of anodisation and other factors. Micrographs revealing a well-defined porous structures and also the presence of double layers etc., have been obtained.

456. Carbonization of Indian Woods.

S. P. MUKHERJEE and S. K. NANDI, Kharagpur.

Some common Indian woods and seeds were carbonized at 3 different temperatures—400, 550 and 700°C. The primary carbon was tested for its adsorptive power, the liquor analysed by A.S.T.M. distillation and the gas by Orsat. The following table shows the materials carbonized, the yields of products obtained with decrease in the temperature of carbonization and the adsorptive power of the primary carbon.

	Yield from 100 gms.			Adsorption (mg/gm carbon)	
	Carbon gms.	Liquor c.c.	Gas litres N.T.P.	Iodine	Methylene blue
Sal (Sorea robusta) ...	30·5-35·5	43·0-42·2	18·0-12·0	240—180	4-3·9
Banyan	29·8-36·2	44·0-39·0	19·3-10·0	319—210	9·5-6·4
Guava	28·0-34·8	45·0-40·5	17·6- 9·8	356—255	7·4-4·4
Kul (ZizyphusZuzuba)	28·0-34·14	45·2-41·7	19·7-11·0	224—340	6·8-10·0
Bamboo	30·3-38·0	44·0-38·8	19·9- 9·7	332—231	7·2-4·4
Coconut Shell ...	28·3-32·9	46·0-45·4	16·2- 9·5	319—174	1·1-3·9
Amrha (Spondias magnifra).	26·4-36·2	44·4-39·1	17·9- 9·8	401—331	11·4-9·0

It will be seen that the adsorptive power of primary carbon obtained from Amrha is very much higher than other carbons. Further work on the preparation of active carbon from these materials is in progress.

457. Studies on Air Activation of cokes. III. Active Carbon from Singareni Coke.

T. L. NARASIMHA RAO and D. S. DATAR, Hyderabad-Deccan.

Active Carbon samples on a pilot plant scale were prepared from coke obtained by the low temperature carbonisation of Singareni Coal. Trials were made using two ranges of temperatures viz., 400—450°C and 550—600°C and different periods of air activation and the samples were tested for the decolorisation of molasses.

458. Studies on Air Activation of Cokes. II. Active Carbon from Jambad and Upper Kajora cokes.

T L. NARASIMHA RAO and D. S. DATAR, Hyderabad-Deccan.

Active carbon samples were prepared from cokes obtained by the low temperature carbonisation of Jambad and Upper Kajora coals. The products at different stages of air activation were tested for decolorisation of molasses.

459. Use of Crystalline varieties of Limestone in production of Calcium Carbide.

A. JOGARAO and M. SUNDARAM, Karaikudi.

While freedom from deleterious impurities is an essential pre-requisite, the physical and mechanical properties of lime to be used are also of great and almost decisive importance, since too much dust arising from the use of friable and brittle raw materials, in actual experience, is found to cause furnace blow-outs and other difficulties. As a matter of fact large quantities of crystalline limestone of high purity available at Ramayanpatti, Sankaridrug and other places in South India were pronounced to be unsuitable, chiefly on account of the brittleness of the lime.

Studies reported in this paper show that contrary to the conventional practice, if straight limestone of suitable grain-size is used instead of burnt lime, the above difficulty could be largely obviated. Experiments were carried out in an arc-furnace, operated on a 45-KVA transformer. Charges of about 10 lbs. were used in each experiment comprising crystalline limestone (different graded sizes), charcoal and petroleum coke. Both the furnace operation and the quality of resulting products were found satisfactory. A 148-KVA transformer has been procured for further trials of continuous operation in a larger-size furnace.

460. Chemical Examination of the Essential Oil from Laurel (Laurus Nobilis) Berries.

I. C. NIGAM, D. R. DHINGRA and G. N. GUPTA, Kanpur.

The essential oil obtained by the steam distillation of the shell of laurel berries, known as Sugandh Kokila in Hindi, in an yield of 3·9-4·1% has been examined for its physico-chemical properties and chemical composition. The oil had the following physico-chemical properties :

$$n_D^{20}\ 1{\cdot}4898,\ D_{20}^{20}\ 0{\cdot}9218,\ \alpha_D^{20} - 18{\cdot}9,\ \text{A.V. } 5{\cdot}92,\ \text{S.V. } 67{\cdot}94.$$

S.V. after acetylation 99·80, percentage of carbonyls by neutral sulphite process 12·0, percentage of carbonyls by oximation (standard process) 19·38, alkali solubles 9·0% by volume.

The oil was fractionated under reduced pressure, after the removal of free acids and phenols, using an efficiently packed column. The individual fractions were analysed for their physico-chemical constants and the constituents present in some of them were identified. The oil was found to contain 12·8% cineole, 10·67% free alcohols (mostly tertiary in nature), 17·91% esters: chiefly methyl cinnamate, 1·56% free cinnamic acid, 2·0% free phenols, 15·4% terpene hydrocarbons: chiefly l-α-pinene and l-β-pinene. The oil was also found to contain carbonyl compounds and some sesquiterpenes.

Identification and characterisation of phenols, carbonyl compounds, sesquiterpenes and the tertiary alcohol is in progress.

SECTION OF GEOLOGY AND GEOGRAPHY

President :—Dr. A. G. Jhingran, M.Sc., Ph.D., F.N.I.

Abstracts

A. GEOLOGY

(i) General Stratigraphy & Structural Geology

1. New Finds of Inter-Trappean Beds in Mandla District.

M. SRIRAMA RAO, Jabalpur.

Inter-trappean beds have been located for the first time in a number of localities in the Satpura region in the north-western corner of Mandla district. A detailed account of these occurrences and their organic remains are given in the present paper. The beds are mostly discontinuous occurring as small patches and are nowhere more than five feet in thickness. They are met with in the following places in order of importance : (i) close and about a mile east of Samnapur, (ii) about a mile north-west of Bijadandi, (iii) half a mile south-west of Khapa, (iv) in the Dobhi Reserve Forest area east of Mohgaon and (v) at Pawai. The cultivated land in these localities is strewn with boulders of chert. The beds are of cherty limestones whitish to pinkish in colour. There has been replacement of calcareous matter by silica, even the fossil remains as seen in thin section, being made up of clear cryptocrystalline silica. The fossils which are fairly abundant range in size from microscopic dimensions to about 2 inches across. They are mostly gastropods and of them *Physa prinsepii* is the commonest. In addition, *Paludina, Limnaea, Melania* and *Vivipariadae* as also broken fragments of shells of lamellibranchs and petrified palm roots have been recognized.

The occurrence of a band of inter-trappean limestone brought to light earlier by the author (1957) has served to establish the thickness of the first flow in the Jabalpur area to be about forty feet. The occurrences reported in the paper are mostly confined to the third and fourth flows and in all five distinct flows have been recognized so far in this part of the Satpura region.

2. Some observations on the stratigraphy and tectonics of the region around Ankleshwar, Broach district, Bombay.

K. N. PRASAD and D. K. RAY, Calcutta.

The area under report was previously mapped by Full James (1838), J. Carter (1854) and W. T. Blanford (1869). During the field season 1955-56, while engaged on a reconnaissance of the area around Ankleshwar (21°38′ : 72°59′20″), the authors noted some additional geological details concerning the stratigraphy and tectonics of the region. The structure of the Tertiary rocks, the thickness of the laterites overlying the Tertiaries are briefly discussed in this paper.

The Tertiaries consist of yellow Nummulitic limestone at the base with alternating bands of conglomerate (often with agate) and calcareous clay at the top. The base of the Nummulitics is not exposed. The lateritic gravel and conglomerate form a capping on the Tertiary rocks and are generally 30-40 feet thick.

Mostly the formations are horizontal or subhorizontal. A sharp and abrupt monoclinal flexure with cross faults was noticed near the villages Limet (21°36' :73°9') and Hirapur (21°34'45" :73°9'15"). This flexure may be due to a fault drag or normal deformation.

3. Uplift of Cuddapahs in Peninsular India.

R. VAIDYANADHAN, Waltair.

Rocks of Cuddapah System overlie the Archaeans unconformably on the south and the southwestern part of the Cuddapah basin. Earlier studies have so far been directed only at the stratigraphy of these formations. An attempt is made here to study the nature, amount and age of the uplift of the Cuddapahs in this part of the basin. For this, three methods of investigations were undertaken, (i) erosion surfaces of the Archaean terrain, (ii) the present position of the Cuddapah rocks above mean sea level over the Archaeans at different places along the Archaean-Cuddapah boundary to a distance of about 180 miles and (iii) the trend and lie of the rocks of different stages of the Cuddapah system. The results from these studies show that (i) the Cuddapahs might have been uplifted at the south eastern corner with a slight tilt towards north west, (ii) the amount of uplift was about 500 to 600 feet and (ii) the uplift might have commenced after the deposition of the Papaghni series and before that of Nallamalai series, both of Cuddapah system.

4. Sedimentary features in Burhai Talchir Basin, S.P., Bihar.

DIPANKAR NIYOGI, Kharagpur.

Talchir sediments in the Gondwana basin around Burhai, off Madhupur, S.P., Bihar have been studied in detail. The lowest unit is the Boulder Conglomerate Complex comprising of an intermingling of boulder-conglomerates and mauve-coloured arkoses and silt-shales which were deposited on an uneven surface of the Archaeans. Fourteen different boulder-conglomerates, six inches to twenty feet in thickness, have been established. Boulders, cobbles and pebbles show the effects of glaciation. The boulder-conglomerates are generally somewhat sorted and stratified and vary laterally through sandstones into siltstones. The following interesting sedimentary features were noted : intraformational conglomerates; "plaster" conglomerates; cross-bedding, ripplemarks and shrinkage cracks in sandstones and siltstones; rafted boulders in sandstones, laminated siltstones and shales; various penecontemporaneous deformation phenomena, especially in layered silts; various types of rhythmic sedimentation including varved sediments containing rafted pebbles. The Boulder Conglomerate Complex is generally overlain by siltstones and silt-shales with frequent drift blocks. These in turn are overlain by chloritic arkoses with the intervention of an angular unconformity.

5. Dextral and Sinistral Wrench faults affecting the cross folded folds between the Dalma and Copper belt thrusts, East Singbhum, Bihar.

S. N. SARKAR, Kharagpur.

In the course of structural and stratigraphic work in parts of Sheets 73 J/6 and J/10 in East Singbhum the author has established the following principal structural units, with their fold axis trends given in brackets. From SW to NE the four units are (1) Benasol anticline (SSE); (2) Doubly plunging Ghatsila syncline (SE); (3) Maubhandar anticline (SE to E); (4) Southern subvertical arcuate flank of the

Dalma synclinorium. On the NW (5) the Galudih anticlinorium plunges SE to ESE. From NW to SE the principal cross folds are (6) Bankati depression (NE to NNE); (7) Deuli culmination (NE); (8) Paharpur depression (ENE to NNE); and (9) complex zone consisting of at least two synclinal and two anticlinal cross folds (NNE).

In this area of complex folds the author has mapped about twenty dextral and sinistral wrench faults which have not been reported by the previous workers. In most of these faults the maximum horizontal separation nearly equals the strike-slip component. Out of twelve dextral wrench faults the important ones are as follows: (a) The Great Burudih fault, with SW to WNW arcuate trend, causes a horizontal separation of the subvertical base of the Iron Ore Stage through 9,150 ft. at the nose of the Bankati depression. This is the largest wrench fault reported in Singbhum. (b) Nischintapur fault with SW to west ward arcuate trend causes horizontal separation of the subvertical base of the Iron Ore Stage through 5,500 feet in the nose of the Paharpur depression. The amount of horizontal separation in ten other dextral faults varies from 70 feet to about 1,200 feet. Out of the eight sinistral wrench faults the most prominent one is the Baghmuri fault which strikes NNE subparallel to the Bankati depression axis for several miles and causes a horizontal separation of the base of the Iron Ore Stage through 4,060 feet. This fault has cut across the Great Burudih fault in a spectacular fashion and so is later in age. The amount of horizontal separation in seven other sinistral faults varies from 50 to 800 feet.

From a careful comparison of the various tectonic units and orientation pattern of the two types of faults it is evident that the dextral wrench faults have been mostly caused by cross folding movement from the SE, and that the sinistral wrench faults have been mainly developed by movement from the north.

6. Note on the Stratigraphical Sequence of the Purana formations of the Drug and Raipur districts, Madhya Pradesh.

N. V. B. S. DUTT, Calcutta.

As a sequel to mapping in the Drug and Raipur districts, M.P., the following stratigraphic sequence of the Purana (Lower Vindhyan) formations has been established.

Lower Vindhyans ...	Raipur shaly limestone. Khairagarh sandstone. Gundardehi shale. Charmuria limestone. Chandarpur sandstone.

. . . Unconformity . . .
Granite

It is noticed that the Khairagarh sandstone is not the same as the Chandarpur sandstone as thought by some earlier workers but is younger than the latter. The grey thinly-laminated limestone of charmuria and the purple shale of Gundardehi are recognised as separate units, which are older than the Raipur shaly limestone, intervened by the Khairagarh sandstone.

7. A note on the Geology of Bhongir, Hyderabad.

(Capt.) S. M. AHMEDUDDIN, Hyderabad.

The paper describes the Geology of Bhongir area. The whole country consists of the archaean crystallines with minor traverses of dyke rocks of a younger age.

The peninsular gneissic rocks and their granitic phases are seen. Many varieties of Archaean rocks differing both in colour and texture are most notable. The gradual change of one type into the other, the intensive character of the younger members. and caught up patches of the older type in the younger ones are seen here and there.

Two important doleritic dykes have been traced. The northern dyke which passes along the Bhongir tank bund and traverses in a N.-E. direction cutting the Raigir hill has been traced for a distance of about 6 miles with a thickness of 50—100 ft. The other dyke runs parallel to the Pagidpully dyke, which is about 5 miles in length and in thickness 40—75 ft.

Most of the rocks are micaceous consisting of black biotite-granite gneisses and some are hornblendic type as well. The dyke rocks are either amphibolite dykes or typical dolerites which are fine or medium grained.

8. Penecontemporaneous Deformation and its relation to the Paleocurrents in the Iron Ore Series rocks of East Singbhum, Bihar.

S. N. SARKAR, Kharagpur.

As a result of thorough investigation of the para-metamorphites of the Chaibasa Stage of the Iron Ore Series between latitudes 22°33′ and 22°43′ and longitudes 86°22′ and 86°30′ in Sheet 73 J/6, East Singbhum, the author has found excellent evidences of penecontemporaneous deformation not reported by the previous workers. The para-metamorphites mainly include bands of quartzite alternating with mica schists of varying composition. Usually the sandy layers exhibit penecontemporaneous deformation; each deformed unit, mostly with truncated top, is confined between two undisturbed layers. Such deformed units, a few inches to a foot or more in thickness, show the following structures: (1) Overfolded foreset bedding or cross-lamination; (2) Intercalated intraformational contorted zones of various types; (3) Sealing wax flow; (4) Snow ball or spiral roller structures. The axes of such folds and rollers are independent of the tectonic fold axes. All the evidences strongly suggest that such soft rock deformation structures are mostly formed by subaqueous sliding of water soaked sandy layers down the slope, and that the axes of these overfolds and spiral rollers are perpendicular to the direction of primary slope and consequently to that of the current.

In about 30 selected localities over an area of 50 sq. miles paleocurrent directions, determined .by stereographic rotation (for tilt correction) of the axes of the penecontemporaneous overfolds and rollers, exhibit a remarkable regional uniformity and show maximum concentration between north and NNE. In each case the tilt corrected azimuths of the cross lamination in the adjoining upper and lower layers generally show preferred orientation subparallel to the determined current direction. From the paleocurrent map, preferred orientation diagrams and the calculated mean direction it is quite apparent that these sediments were mainly derived from a land mass south of the present outcrop. Most of these rocks, however, have been affected by later orogenic movements.

9. A Study of Fossil Ripples of Alwar Quartzites of an area East of Mera ka Gurha near Udaipur, Rajasthan.

V. K. VERMA, New Delhi.

The present note gives a brief account of the fossil ripples of the Alwar Quartzites of an area East of Mera ka Gurha village and about 6½ miles NE of Udaipur city (24°35′; 73°41′) in Rajasthan. Both symmetrical and asymmetrical types of fossil ripples have been recorded. In the case of asymmetrical ripples, the average ripple index calculates out to 4·97 and the mean horizontal form index measures out to 2·1. It is further observed that the stoss makes an angle between 15° to 20° with respect to the horizontal and the leeside forms the angle between 30° to 35°. An attempt is made to decipher the palaeographical, ecological and other conditions that were present at the time of the formation of ripples. The presence of symmetrical ripples and a low value of the horizontal form index together with a moderate difference in the angles formed by the stoss and leeside with the horizontal in the case of asymmetrical ripples suggest that the velocity of the current during the course of ripple formations was moderate. In general, the pattern presented by the fossil ripples is irregular, and at times the crest of one set of ripples is seen to be in front of the trough of the other, forming a clean linear depression corresponding to perhaps, zero displacement. It might be due to interference of more than one set of ripples, and hence may be called Interference fossil ripples. The presence of interference fossil ripples suggests the cross current activity—a fact which is further supported by the occurrence of cross bedding. The Aravallis and Delhis are geosynclinal deposits. The occurrence of fossil ripples and current beddings are the earmarks of the platform facies of sedimentation, which in fact is taken to contrast with the graded bedded arenites of geosynclines. To explain this, it may be expected that these mechanical inorganic structures of ripple marks and current bedding were formed either at the margin of the geosyncline or represents an isolated patch.

10. Environment of Sedimentation in the Burhai Talchir Basin, S.P., Bihar.

DIPANKAR NIYOGI, Kharagpur.

The sedimentary environment as interpreted from various sedimentary features observed in the Gondwana basin around Burhai, is as follows.

Glacial outwash deposits varying laterally into glaciolacustrine deposits in glacial kettle lakes were deposited in the glaciated Archaean surface, the glacier front being to the west of the area. The glacier was advancing towards the east and the fourteen alternations of boulder conglomerates and arkoses probably indicate oscillations of the advancing glacier front. The Boulder Conglomerate Complex originated under these conditions.

After a time period not represented in the area by sediments, the glacier front receded far back to the west and sedimentation of the silt-shales and shales took place in a big lake in which icebergs were frequent. After the period of unconformity, the top arkoses were deposited in a lake with subsiding bottom, which was somewhat smaller than the previous lake. Deposition was in the form of lakehead deltas. The direction of current-flow was uniformly from the west.

The origin of the basin is not definitely known. The absence of "wedge arkoses" on the sides of the basin indicates that the basin did not originate as an elongated faulted trough in which sedimentation took place later on. A suggestion is put forward that this basin might have originated by glacial gouging.

11. Movement Sequence from Petrotectonic Studies in the Singhbhum Shear Zone.

KSHITINDRAMOHAN NAHA, Calcutta.

Mylonites and blastomylonites from the Singhbhum Shear Zone south of Galudih (86°25′:22°39′) show almost identical quartz fabric, generally a girdle parallel to *bc*-fabric plane (normal to fine pucker, mineral lineation and striation in *a*), with a little spread in *ac* due to slight flexure in *b*. A folded mylonite with an amplitude of 1·5″ shows a low southeasterly plunge, which has flexed the northeasterly mineral lineations and fine puckers in *a*. The quartz and mica fabrics are unrollable with reference to the southeasterly fold axis, the quartz fabric in either limb of the fold being almost identical with that of the mylonites not marred by any subsequent movement. Thus the movement forming the southeasterly small folds and puckers was latest in the movement impulses in the shear zone, and was sometimes strong enough only to rotate the quartz and mica fabric *externally*, without changing the details of the fabric.

The movement sequence laid down earlier from analyses of larger scale structures, with mineral lineation parallel to the slip directions during thrusting, followed by puckering along the axis of slip (subparallel to the thrust-front) during hindered transport in the last stage, thus stands confirmed by comparative petrofabric analysis.

12. A Preliminary Note on the Structure and Tectonics of Balarampur Area, Purulia District.

V. RAIVERMAN, Kharagpur.

The paper gives a preliminary account on the structural geology of the area around Balarampur (23°6′ : 86°14′). The country rocks consist of quartzite, phyllite, chlorite-, muscovite- and biotite-schists, calc-granulites, hornblende-schists, amphibolites and granite-gneisses. A fault-zone south of Balarampur extends for more than 9 miles with E-W trend in the western part and ESE-WNW trend in the east. South of the fault-zone, the rock-types chiefly consist of low-grade metamorphites and even unmetamorphosed white clay with iron-ore, whereas to the north there are high grade metamorphites—from the fault northwards they grade from phyllite, muscovite- and biotite-schists through various types of gneisses to different kinds of granite-gneisses. A sheared and mylonitised granite associated with sheared meta-dolerite occur along the fault-zone, particularly in its southern vicinity. Two trends of foliation strike have been observed in the area, one is mainly N-S and the other E-W and ESE-WNW, the latter being sub-parallel to the fault-zone. The fault-zone is parallel to the Dalma thrust and copper-belt thrust of Singhbhum district occurring to the south. At least two phases of orogenic movements are recognisable in the area resulting in the two trends of the strike mentioned above.

It is concluded that the E-W and ESE-WNW orogenic trend along with the fault-zone occurred later than the N-S orogeny.

13. Compressional Wave Velocities in Indian Rocks.

S. BALAKRISHNA, Hyderabad.

Compressional wave velocities in a number of Indian Rocks, have been measured by employing the pulse technique. The travel time of a pulse in a given length of rock sample is measured and velocity is computed therefrom. Variation of compressional wave velocities with direction has been studied. Rocks which are in the nature of polycrystalline aggregates, where the crystallites composing the aggregate are arranged in all possible random orientations in space, should be elastically isotropic. Results of this investigation suggest that rocks are perfectly isotropic. Variation of compressional velocities in rocks, with a low pressure of 4,000 Kg/cm^2 has been studied systematically. It is found that there is a considerable rise in velocity even at low pressures. Porosity seems to have a considerable effect on this parameter namely velocity.

(ii) Palaeontology & Palaeobotany

14. A Note on the occurrence of Radiolarite in Association with the Ultra-Mafic Plutonic Intrusives of the South Andaman Islands.

M. S. JAIN, Calcutta.

While examining a dam-site along the Mithakhari stream, in the Andaman Islands, the author came acrŏss a large exposure of radiolarian cherts in association with serpentinised dunite and enstatite-peridotite intrusives. The ultramafics occur as steeply inclined lenses in the folded radiolarites and the mechanical disturbance has brought out significant recrystallisation of the cherty rocks which show conspicuous development of quartzo-calcitic veination. The radiolarites are isoclinally folded and show overturning towards the west. A preliminary microscopic examination of these cherts has indicated a rich assemblage of Radiolarian fauna which is devoid of all other pelagic forms. It is noted that the group Spumellaria is represented by a large variety of spherical forms of which six have been so far identified. According to Shri R. N. Srivastava, Geological Survey of India, these belong to the following genera : *Acanthosphaera, Prunopyle, Perichlamydium, Stylodictya, Stylotrohus and Stylosphaera*. The elongate form belonging to the group Nassellaria are represented by the genera *Dictyomitra* and *Lithomitra*. These are, however, less abundant than those belonging to the former group. The exclusive occurrence of the radiolaria in association with the ultramafics in this stretch of the geosyncline suggests that the deposition of the radiolaria must have taken place in the deeper levels of the tectogene and preceded the first phase of the orogenic uplift. It is, therefore, inferred that the age of these cherty rocks would probably be Upper Cretaceous. Further the geographic location of these radiolarites and the nature of their associations are also in conformity with the modern concepts of the formation of the Tethyan tectogens and its relationship to the structure of the island arcs.

It is suggested that these cherty rocks may be tried for the manufacture of pouzzolanic admixtures with Portland cement used in the construction of large-scale hydraulic structures, such as, dams.

15. Stromatolites from Fawn Limestone, Semri Series, Mirzapur District, U.P.

S. M. MATHUR, K. NARAIN, J. P. SRIVASTAVA and G. S. M. RAO, Calcutta.

The paper records the presence of biosterm of stromatolites in the Fawn limestone of the Semri series (Lower Vindhyan) in the stone quarries near Pataudh hill. The discovery was made during a study tour of the Vindhyans of Sone Valley in the company of Prof. F. J. Pettijohn of Johns Hopkins University, Baltimore, Md., U.S.A. The stromatolites occur as vertical columns which measure upto one meter in height and two to eight centimeters across. Each column is made up of thin semi-circular laminae with convex surface towards the top. The differential weathering of these hard columns inside the calcareous matrix of the rock gives a nodular appearance to the weathered surface of the outcrop. The columns are closely spaced, but are generally separated from each other by calcareous matrix. Since stromatolites are regarded to have been formed by algae, they are of considerable importance as shedding valuable light on the problem of life in the Vindhyan period.

16. Equisetale Compressions from East Coast Gondwanas.

B. B. G. SARMA, Waltair.

Fossil flora described from the Golapilli stage from the type area near Golapilli (80°58′; 16°43′) and surroundings, includes species of Filices, Cycadeaceae, and

Conifers, and is regarded as representative of the Rajmahal flora on the south-eastern coast of India. The paper records for the first time, the occurrence of Equisetalean stem compressions from Buravancha (80°50′30″; 16°45′) and east of Digavalli (80°53′; 16°52′) to the north of Golapilli. Specific identification was not possible because of imperfect preservation in ferruginous shaly sandstones. The Equisetales, though quite common in the type area for Rajmahal flora, have not so far been reported from the equivalent Gondwanas of the east coast.

17. Palynological Studies on Salt, Shale and Coal from Mandi and the age of the Coal Beds.

A. K. GHOSH and Y. K. MATHUR, Dehra Dun.

Ten samples of salt, coal and shale collected from Mandi by Shri A. M. N. Ghosh were analysed for its spore and pollen contents. Analysis was done by Schultze solution enriched with heavy liquid. Spores and pollens recovered from two coal samples are as follows :—

Pteridophytic	11 (7·6%)
Gymnospermous	97 (67·8%)
Angiospermous	22 (15·4%)
Indeterminates	13 (9·2%)

Of the gymnospermous pollen the largest individual group (54·2%) belongs to the genus *Pinus*. Very few pollen grains of *Cedrus* or *Abies* were observed.

From the data available the coal bed is likely to be of early Tertiary in age.

(iii) Mineralogy

18. Titan-Clinohumite from Calc-Silicate Rocks of Ambasamudram, Tinnevelly District, Madras.

S. NARAYANASWAMI and P. D. MALHOTRA, Calcutta.

Detailed optical, X-ray and chemical studies of the Chondrodite from calc-silicate rocks near Ambasamudram, Tinnevelly District, Madras, have shown that what is thought to be chondrodite is in fact "Titan-clinohumite" with high TiO_2 of 1·14 per cent. Its chemical composition and structural formula is nearer that of clinohumite than chondrodite, but with an unusually high TiO_2. X-ray powder diffraction pattern indicates clinohumite identical with Sahama's clinohumite from Finland. Optical properties like indices of refraction and 2V are more towards chondrodite than clinohumite, with Ng 1.·616 ± ·001, Nm 1·629 ± ·001, Np 1·652 ± ·001 and 2 V 86°-88°. A comparison of chemical composition and optical properties of 21 specimens of humite group of minerals from different parts of the world gathered from the literature indicates that the medium Nm index of 1·629 for Tinnevelly titan-clinohumite confirms Rankama's conclusions that the index represents the algebraic sum of different factors like FeO, MnO, TiO_2, F and H_2O contents. In view of the unusually high TiO_2 and somewhat anomalous optical properties, the Tinnevelly mineral is probably a link in the isomorphous series Chondrodite-Clinohumite as suspected by Bath. Non-availability of enough chemical and optical data regarding titaniferous chondrodites and clinohumites makes it difficult to locate the exact position of the Tinnevelly clinohumite in the above isomorphous series.

19. Wollastonite bearing Calc-silicate rocks of Tinnevelly district.

P. LAKSHMI, Calcutta.

The mineralogy and petrography of calc-silicate rocks from different localities in the Tinnevelly district are described. These rocks occur as layers, lenses and stringers in the gneisses near limestone and quartz vein contacts. Thin sections of these rocks displaying cataclastic textures indicate their having undergone deformation during regional metamorphism. Detailed optical determinations were made. Wollastonite ($X \wedge C = 32^\circ$; $2V = +38^\circ$; R. I. $\alpha = 1{\cdot}612 \pm {\cdot}002$, $\beta = 1{\cdot}627 \pm {\cdot}002$, $\gamma = 1{\cdot}632 \pm {\cdot}002$) is abundant, the other minerals being clinopyroxene (Di_{90} He_{10}), calcite, scapolite (Ma_{35} Me_{65}), felspar (chiefly microperthite), garnet and sphene. Twinning parallel to elongation in wollastonite and zoning in pyroxene and scapolite are noteworthy. The mineral assemblages in these rocks are similar to those described in the literature. The formation of wollastonite may be attributed to reaction between the limestones and intrusive quartz veins. Further work is in progress to elucidate the genesis of this mineral. A detailed account of this will be presented elsewhere.

20. On Mangan—Uralite from Ponia, Balaghat District, M.P.

SRIPADRAO KILPADY and A. S. DAVE, Nagpur.

A coarse pegmatite at Ponia, Balaghat District, M.P. contains pseudomorphs (after Blanfordite) and radiating aggregates made up of needles of a pink amphibole.

The mineral shows the following optical characters :

Rhombic cleavages in six sided basal sections; X = light pink; Y = pale brownish to yellowish; Z = faint blue; $X > Y = Z$; $\alpha = 1{\cdot}65 - 1{\cdot}66$, $\beta = 1{\cdot}66 - 1{\cdot}67$; $\gamma = 1{\cdot}66 - 1{\cdot}67$; $\gamma - \alpha = 014$; ultrablue interference colours, optically negative; 2V large, Op. Ax. Pl. parallel to 010; $X \wedge C = 30^\circ$ on 010.

Chemical Analysis : $SiO = 55{\cdot}35\%$; $Al_2O_3 = 3{\cdot}52\%$; $Fe_2O_3 = 12{\cdot}21\%$; $MnO = 3{\cdot}08$; $CaO = 2{\cdot}17\%$, $MgO = 14{\cdot}54\%$, $Na_2O = 7.44\%$; K_2O = Trace ; $H_2O = 2{\cdot}90\%$; Total = 99·85.

The pink amphibole has been formed by uralitisation of Blanfordite and hence can be regarded as a mangan-uralite. The pink colour (distinct from normal uralites) is obviously due to the manganese content. This is the first time that a mangan-uralite has been reported.

21. A Note on the Origin of Felspar Ovoids in Limestone near the Contact of Nepheline—Syenite, Kishengarh, Rajasthan.

T. C. BAGCHI & A. CHATTERJEE, Kharagpur.

Ovoids of nepheline in limestone from the contact-zone of nepheline-syenite have been reported by Bagchi (this journal 1957, p. 180), near Ransamed Talab, Kishengarh. Further work in the area has revealed the presence of felspar (mostly of K—variety) ovoids in limestone occurring in association with nepheline. The K—felspar (2Vx—81°, Nz—1·528) ovoids are pink in colour and vary widely in size, the larger ones extending over 5 cm and the smaller ones are ·3 mm across. They occur either as separate ovoids or as aggregates along with nepheline, plagioclase (An_{10}--An_8),. cancrinite, etc., and show persistently gradational and irregular boundaries with the carbonate host. Strong deformation structures in the form of peripheral mortarization, presence of fissures filled up with granulated material, bent and offset twin-lamellae etc., are in sharp contrast with the carbonate matrix which hardly shows signs of deformation and crystallization.

It appears from the gradational and irregular boundaries of the ovoids, the presence of relics and islands of carbonate matrix within the ovoids, the preferential deformation of the ovoids, the replacement features shown by the constituents of the ovoids, the presence of fluorite, apatite etc., that these were perhaps formed by the replacement of the original carbonate rock by alkaline solutions, genetically connected with the emplacement of the bordering nepheline syenite mass at a low temperature.

22. Mineragraphic and Textural Studies of the Manganese Ores of Dongri Buzurg, Bhandara District, Bombay State.

SUPRIYA ROY, Jadavpur, Calcutta.

The manganese ore deposits of Dongri Buzurg, Bhandara Dt., Bombay State occur in mica schists and spessartite-quartz rocks interbedded with white, pinkish and dark grey quartzites. The ores occur as concentrated bodies or bands of variable width in spessertite-quartz rocks and also as pockets, nodules and replacement veins in the mica schists and quartzites.

Mineragraphic study of the polished sections of these ores revealed the presence of the following ore minerals: Psilomelane, pyrolusite, manganite, hollandite, braunite, jacobsite, hausmannite, hematite and coronadite. Texturally and in modes of occurrence, the ores may easily be divided into two distinct suites: (i) Braunite-jacobsite-hausmannite-manganite assemblage exhibiting schistose texture and in part gneissose banding, and (ii) Psilomelane-pyrolusite-manganite-hollandite-hematite-coronadite assemblage exhibiting texture suggestive of colloidal deposition from a gel. The first type of ore (braunite-jacobsite-hausmannite-manganite) occurs as bands or continuous lodes in spessertite-quartz rocks while the second type occurs as big nodules, stray pockets or cavity fillings replacing the mica schists and the quartzites.

The braunite-jacobsite-hausmannite-manganite association definitely crystallised at higher temperatures and exhibit schistose alignment of hypidioblastic to granoblastic grains. Gneissose banding is also found in some ores and the effect of pressure is always in evidence. The psilomelane-pyrolusite manganite-hollandite-hematite-coronadite, on the other hand, is a typical low temperature assemblage exhibiting typical colloform textures. These ores are abundantly associated with agates and chalcedonic varieties of quartz. Psilomelane of different generations, exhibiting slight difference in colour and reflectance occurs as successive bands, at places changing over to pyrolusite by dehydration. Manganites generally occur as needles oriented perpendicular to the boundaries of vugs and cavities as also the concentric rings of colloform psilomelane. Hollandite occur as plates and elongated laths. Coronadite and hematite occur as individual bands.

Further studies about the origin of these two divergent types of manganese ores occurring side by side, are in progress.

23. Mineragraphic Studies of some Sulphide-Mineral bearing veins near the Trijunction of Bankura, Midnapore and Purulia Districts.

PRIYA SANKAR CHAKRAVORTY, Jadavpur, Calcutta.

A number of sulphide mineral veins crop out near the trijunction of Bankura, Midnapore and Purulia Districts, amidst pelitic, psammopelitic and basic schists. Dey (1942) noted the occurrence of galena in a quartz vein half-a-mile W.S.W. of Kama. The present author located three more quartz veins bearing sulphide mineral in the area. One of them crops out near Dungrikuli (22° 53′ 25″ N :

86° 42′ 50″ E) amidst garnetiferous mica-schists and epidiorite-schists. The foliation dip of the country rock is 50°-55° towards N.N.W.; the vein dips in the same direction. The other two sulphide-mineral bearing quart veins were located near Burisal (22° 47′ 30″ N : 86° 42′ 30″ E) and Kawatanga (22° 47′ 15″ N : 86° 42′ 45″ E) respectively. The country is constituted of garnetiferous mica-schists and quartz-muscovite-biotite-graphite-schists which dip at a very high angle of 75°-80° towards S.E. The veins always run parallel to the foliation strike of the schists. Highly sericitised nature of the schists, acute puckering, and occasional presence of silicified breccians indicate that the area is in a dislocation zone.

The milk-white quartz veins are seamed with blue-grey quartz with which the sulphide minerals are generally associated. Mineragraphic studies of the polished ore-samples were made under the reflecting microscope and also some thin sections were studied. Galena is the most abundant of the sulphide minerals, while sphalerite, arsenopyrite, pyrite, pyrrhotite are common. Electrographic contact print with the polished specimens gave scattered red violet spots suggesting presence of silver in galena. Only in one specimen a silver mineral, pronsite could be identified. The reflectivity of the minerals were determined in Berek's photometer using green filter.

Pyrite was the earliest mineral to crystallise. Arsenopyrite started to crystallise later and the time of crystallisation of pyrite and arsenopyrite overlapped. Some deformative force fractured the pyrite and arsenopyrite grains before sphalerite invaded them. Galena replaces pyrite, pyrrhotite, arsenopyrite and sphalerite abundantly, but shows a selective preference for sphalerite. The silver mineral invades galena along grain boundary. The blue-grey quartz has replaced galena quite abundantly; the replacement has often been guided by cleavage planes. Iron from pyrite and arseno-pyrite has altered to goethite. Anglesite, an oxidation product of galena sometimes forms rims around galena veinlets.

24. Importance of Geological background in Correlating Clay Minerals and their Properties.

(A Plea for Coordination in Research)

R. N. P. AROGYASWAMY, Calcutta.

Developments and trends in the study of clays and soils have been briefly reviewed in this paper and a scheme of correlation of physical and mechanical properties etc., with the mineralogy of clays and soils has been indicated. A case is made out for the formation of a Clay Mineral Society, with the same aims and on the same basis as those of the Clay Mineral Group of Great Britain, or the Clay Minerals Committee of the U.S.A. Today, clay research has become too wide a field for individual study and unless coordination and free interchange of ideas are possible, no clay research project can be complete. It is pointed out that of the institutions interested in clay or soil research, it will not be possible for anyone of them singly to undertake research into all aspects even though this may, at times, be very necessary. A Clay Mineral Society consisting of all interested workers in clays or soils on the other hand, if endowed with sufficient funds, will be the most competent body for undertaking detailed studies on clay minerals or properties of clays.

25. An Occurrence of Pumicite near Khumbi, Athmallick State.

R. N. P. AROGYASWAMY and S. BANNERJEE, Calcutta.

This paper presents the results of the examination of the pumicite from Khumbi originally designated as Khumbi Clay and some points of interest arising out of the location of the deposit are also discussed. The chemical analysis shows the material to have a composition which agrees closely with those of known trachytic lavas. On microscopic examination, the coarser portions of the material reveals the presence of mainly glass with an R.I. 1·503 ± ·001 and having a sp. gr. of 2·40. These values also correspond to those of trachytic glasses. The glass fragments present typical semicircular and crescent shaped "shard" textures, besides bubble textures and thin plates with vertical, triradiate or parallel septa. Quartz, felspars, augite, micas are also seen in subordinate amounts in the coarser fraction. The finer fraction consists mainly of clay minerals—especially illite, montmorillonite with subordinate hydrated halloysite and gibbsite (?). Optical and the D.T.A. methods were utilised in the identification of these minerals. The characteristics of the thermogram obtained are also discussed.

26. The Origin of Kaolin and Indications of Kaolin Occurrences in the Singhbhum and Saraikela Districts, Bihar.

R. N. P. AROGYASWAMY, Calcutta.

The author examined the several kaolin deposits in the Singbhum and Saraikela districts of Bihar State, during the course of his field duties in the Geological Survey of India. According to the mode of occurrence, these deposits have been grouped as (1) those lying within the granite area and (2) those lying outside the granite area. In this latter group are included the deposits of sedimentary kaolin. While discussing the origin, the possible factors or agencies for kaolinisation, have been differentiated as epigene and hypogene. Under th former, consideration has been given to the action of ground water, influence of structure, topography, climate, etc. Indirect evidence has been adduced for the possible influence of hypogene agents, e.g., presence of Newer Dolerite, quartz veins, depth of kaolinisation, etc.

27. Thermal Studies of Clay Minerals from some Sedimentary Formations of Andhra Pradesh.

B. B. G. SARMA, Waltair.

Eleven clay mineral extracts from shales and shaly sandstones equivalent to Kamthis, from the Somavaram (80°55′; 16°55′) and Chintalapudi (81°3′; 17°3′) areas were studied by Differential Thermal Analysis. The presence of Kaolinite group of clay minerals is indicated. The Kaolinites would have been formed by the erosion of the para gneisses and schists, which are the source rocks for the Chintalapudi sandstones, and are suggestive of deposition under continental conditions, possibly in a fluvio-lacustrine environment.

28. Mineralogical Studies on two Clay samples from the Liassic of Gottingen, West Germany.

A. K. BHATTACHARYA, Varanasi.

Investigations of the mineral-composition of two clay samples from the Liassic of Göttingen, W. Germany by optical, electron-optical, differential thermoanalytical and röntgenographical methods have shown that they consist principally of illite, kaolinite, chlorite and quartz with some haematite and goethite. Calcite, gypsum and felspar are also present, but in subordinate quantity. Diffraction studies have shown that the illite is mostly of the dioctahedral type. The kaolinite is a rather poorly crystallised variety and the chlorite is iron rich. Further, clay minerals with mixed layer structures are practically absent. Montmorillonite, swelling-type chlorite and halloysite are also not found.

29. On various types of Chrome Ores around Jojohatu, Singhbhum, Bihar.

KRISHNA KANT SINGH, Kharagpur.

The chromite deposits around Jojohatu (22°31′—85°38′) have been classified chiefly on the basis of structure, and association of gangue minerals. A brief account on the localisation, structure, shape, size, texture, genesis and uses of these ores are presented in this paper.

The following structural types of the ores are recognised: banded or reef, schilleren banded, lenticular or sackform, float or boulder, leopard or spotted, spongy and disseminated or evenly scattered chromite. The associational type consists chiefly of magnetitic, hematitic, limonitic or laterite, steatised, carbonatised and chertified ores. The more common gangue minerals like serpentines and altered pyroxenes, have not been included under this classification. Based on physical characters, the chromites group themselves into hard, soft, massive, granular, pitch black shining, brown and yellow types. The chromite ore bodies in the area occupy various positions within the ultrabasic mass, but more often at or near the contacts and follow more or less parallel to the boundaries. The ultrabasic masses with their included chromite ore have been internally highly folded and faulted. The detailed field and laboratory investigations point out to the magnatic nature of the chrome ores. The associational types are interpreted as due to subsequent hydrothermal changes within the ultrabasic mass.

Further investigations with regard to the origin, composition and beneficiation of the chrome ores of this area are in progress.

30. X-Ray Study of Manganese Minerals from various Indian Deposits.

B. MUKHERJEE, Calcutta.

A systematic study of manganese minerals (groups of oxides, manganates and silicates only) in various Indian deposits has been made by X-ray powder diffraction method.

Stalactitic psilomelane from Vizagapatnam deposit is found to have an inner dull core of cryptomelane and an outer fine-grained crust of pyrolusite. Both pyrolusite and cryptomelane occur in the tetragonal form in the same ore body and have exactly the same 'c'—dimension and nearly a simple multiple relation for the 'a'—dimension. Such an intimate intergrowth suggests that the variation in crystal growth has taken place by alkalies in cryptomelane along the 'a'—dimension only. Vaux's orthorhombic "psilomelane", a hydrous barium manganate, was found in Jhabua and Bilaspur deposits, Madhya Pradesh. A rare natural occurrence of ramsdellite (dimorph of pyrolusite) is reported from Dongri Buzurg (M.P.) and Sandur (Mysore) deposits.

Jacobsite is found to occur in Tirodi and Kodur deposits with a cell size varying between 8·42 Å to 8·52 Å. Spessartite-garnet is found in the Vizagapatnam deposits with a cell-size varying between 11·70 A to 11·95 A. Sitaparite is found to give a powder pattern similar to that of bixbyite, but cell-size of sitaparite is larger (9.40 Å against 9·37 Å for bixbyite).

(iv) Petrology

31. On the Nature of the Basement Complex.

K. P. RODE, Udaipur.

The nature of the basement rocks in Continental Shields has proved to be a highly controversial subject in the geological literature. The diversity of rock types, igneous, sedimentary and metamorphic under extremely variable structural relationships have proved too complex particularly from the stratigraphical point of view. These formations are exposed over vast areas in the nature of peneplaned terrains over which younger sedimentaries are found to occur with strong discordance. The problem of the basement rocks in the tectonic regions has often been subjected to revised age relationships so that what were once considered as Archaean on the basis of high degree of metamorphism have been proved to be much younger and even at times Tertiary on the basis of fossil finds.

The author has discussed the constituents of the basement complex and their possible modes of evolution which may effect our ideas on the age relationships of the basement formations in the continental shields.

32. Occurrence of Basalt in the vicinity of Daltonganj in Palamau District, Bihar.

S. N. WAKHALOO, Patna.

In a recent survey of the area around Daltonganj a narrow outcrop of basalt, hitherto unnoticed was observed on the north eastern flanks of Chindol Hill about 11 miles south east of Daltonganj. The basalt occurs intruding the country rocks in the form of a narrow dyke and has brought about a thin veneer of alterations by contact metamorphism. When we realize that the nearest known occurrences of lava flows are at a distance of over one hundred miles from it, the significance of the present occurrence is considerable in as much it represents the products of later stages of magmatic differentiation. The rock is compact, hard, aphanitic and dark. Its specific gravity is 2·96. In thin section seen under the microscope it appears to be a typical basalt with idiomorphic phenocrysts of labradorite (1 mm. to 1·5 mm. in length) set in a groundmass consisting of plexus of plagioclase microliths of andesine to labradorite in composition and varying up to 0·27 mm. in length, granular purplish brown augite and interstitial glass rendered opaque by granules of iron ore.

33. On the Nature of Malani Rhyolite Western Rajasthan.

K. P. RODE, Udaipur.

Specimens of Malani Rhyolite were collected from near Jodhpur during geological excursion to Western Rajputana by students of the Rajputana University. A study of these samples under the microscope yielded evidence which clearly suggests the phenomena of fusion of sedimentary quartz grains and their Feldspathisation through the contact effects of basic intrusives.

The same phenomenon was observed in the microsection of the type sample of Malani Rhyolite as obtained from the Geological Survey of India. It, therefore, appears possible that the Malani Rhyolites are only a fused facies of the Vindhyan Sand-stone which are commonly found associated with these Rhyolites in the region.

34. Origin of Banded Structure in Gabbros of Mandwara Igneous Complex, N-W. of Abu Massif, Rajasthan.

K. P. Rode and T. R. SHARMA, Udaipur.

During the detailed study of Mandwara Igneous Complex, a remarkably curious feature encountered was the occurrence of extraordinarily well developed "Rhythmic layering" displayed by some gabbros. These rocks exhibit alternate laminae of dark and light coloured bands composed of pyroxene, olivine and hornblende on the one hand and basic plagioclases on the other. The bands do not possess very sharp contacts. They are roughly contorted into micro-folds and show gradational intimate interlocking of mafic and felsic minerals along the junctions. Generally their thickness is less than a centimetre each. Such banded rocks, have inspired many a pen all over the world. The diverse theories ranging from normal gravitational differentiation of a homogeneous magma to intermixing of diverse magmas, auto-intrusions, liquid diffusion, mineralizers, gas flotation, thermal convection currents etc. have given rise to voluminous literature. This paper has discussed these theories in the light of the field and laboratory evidences presented by Mandwara banded gabbros and it has been shown that the phenomenon calls for altogether a new approach, that is, dissociation of monomineralic hornblendic solid phase into contrasted mineral species of greater thermodynamic stability under the influence of pressure-temperature variations generated and controlled by crustal movements. This conception appears to explain all the controversial features associated with these rock types

35. A Preliminary Note on the Apatite-Magnetite Veins Around Ramchandra Pahar, South of Tatanagar, Singbhum Dt., Bihar.

A. K. BANERJI, Calcutta.

The apatite-magnetite veins occurring around Ramchandra Pahar (22° 43′ :86°14′), Singhbhum Dt., Bihar have been studied. The Ramchandra Pahar is composed of chlorite-schists and is enclosed by soda-granites. The latter have been shown to be of metasomatic origin formed by the replacement of pre-existing argillaceous schists and phyllites by at least soda and silica. The chlorite-schists, which were intercalated in the argillaceous schists and phyllites, remained more or less immune to the attack of these sodic solutions, except in their peripheral regions where the solutions entered the planes of schistosity of the chlorite-schists in a lit-par-lit manner and replaced them. The zone of replacement is almost continuous around Ramchandra Pahar and varies in thickness from a few feet in some places to about 300 feet at others. Most of the rich apatite-magnetite veins occur in this zone. The petrological and mineralogical features of the apatite-magnetite vein materials indicate that these are secondary in nature. Their mode of occurrence and geological setting suggest that these are genetically related both to the chlorite-schists and to the soda-granites. It has been suggested by the author that the sodic solutions reacted with the peripheral parts of the chlorite-schists specially in depth, and became enriched in CaO, FeO, TiO_2, and P_2O_5 in which the chlorite-schists were rich. Thus enriched these solutions moved upwards where either due to relief of pressure or due to fall in temperature the parent liquid of the apatite-magnetite veins separated out from the sodic solutions. This liquid on crystallisation gave rise to the apatite-magnetite veins which are, on this account, replacement deposits (metasomatic) and cannot be regarded as late magmatic hydrothermal (hypothermal) deposits as suggested by Dunn.

36. On the Geology and Petrology of the area around Isri, Dist. Hazaribagh.

V. K. S. DAVE, Varanasi.

This paper deals with the geology, petrology and the metamorphic history of the area around Isri, south of Parasnath railway station (E. Rly.). The area lies between long. 86° 0′ 57″ and 86° 6′, and lat. 23° 57′ 44″ and 24° 0′ 13″. The rocks encountered in the area are hornblende-schists, older amphibolites, quartzo-felspathic-gneisses, younger metabasics, hematite-quartzites, banded hybrid rocks, quartz veins and reefs. The older amphibolites enclose hornblende-schists as inliers. The quartzo-felspathic gneisses occur as alternate bands in these amphibolites. The younger metabasics, which vary from meta-dolerites to epidiorites occur as sills in the older amphibolites. All the rocks have been traversed by fine quartz veins. North of the railway station, there is a weak zone, marked by the presence of crushed epidiorites. The rocks of this area show albite-epidote-amphibolite facies of regional metamorphism. The metamorphic facies becomes higher around this area. It has been thought that the intrusion of the basic magma and its subsequent metamorphism led to the development of the bandings in the older amphibolites. There was a further intrusion of calc-alkali magma. Structural deformations took place after this period, accompanied by large scale regional metamorphism. The acidic materials were the last to be intruded in the area.

37. Petrological Note on the Ultramafics of Hatgamariah, Singhbhum.

MIHIR KUMAR BOSE, Calcutta.

Ultramafic rocks occur near Hatgamariah (22°16′ : 85°45′) mostly as dyke like bodies having a north-south trend, within the granitoid gneisses of the area (a part of Singbhum granite) where they are least altered, they show concordant linear parallelism of enstatite crystals near the margin, indicating a stretching of the 'mush' in the direction of trend. The order crystallisation in least altered type is, chromite, olivine ($2V_z = 86°$), enstatite ($\gamma = 1{\cdot}672 - 1{\cdot}676$; $2V_\alpha = 81°$), schillered salite ($\lambda = 1{\cdot}716$; $2V_\alpha = 51°$; $Z \wedge c = 39°$; 001 parting), phlogopite ($\beta = 1{\cdot}580$). Modal analyses of these types fall in family 8, order I, in Johannsen's tetrahedron of ultrabasics and the rocks may be described as salite-peridotites. In the pyroxenite, enstatite ($\gamma = 1{\cdot}677$, $2V_\alpha = 82° - 84°$) constituting about 90 per cent of the rock, occurs together with schillerised salite ($\gamma = 1{\cdot}713$, $2V_z = 52°$, $Z \wedge c = 40°$), and phlogobite. Chemically an originally olivine bearing type falls close to perioditite in Osann's diagram. Both peridotite and pyroxenite show no systematic variation in mineral proportion or in grain size of enstatite and the bodies appear to be crystal intrusions, lubricated by interstitial melt of salic composition. A small ultramafic body north-west of Rankui (22°17′ : 85°42′) is unique in being composed totally of hornblende ($\gamma = 1{\cdot}668$; $2V_\alpha = 74°$; $Z \wedge c = 23°$) and in showing veins of granitic composition near its margin. The younger group of peridotites resemble in many of their petrographic characters, the ultramafics of Champua (22°4′ : 85°40′).

38. A Study of the Kolar "Amphibolite Series" Kolar Gold Field, Mysore.

S. NARAYANASWAMI and B. D. GUPTA, Calcutta.

The hornblendic rocks of the Kolar gold field in Mysore comprise a suite of intensely folded, regionally metamorphosed mafic volcanic rocks and associated sheets and sills of basic intrusives. The earlier workers have distinguished uralite basalt, uralite diabase, spotted schists or porphyritic types, hornblende granulites, hornblende-schists and amphibolites within the "Kolar hornblende-schists". Recent detailed mapping has indicated a sequence of massive amphibolites (massive meta-basalts) and schistose, fissile and amygdular amphibolites (schistose and amygdular meta-basalts), traversed by linear zones of granular amphibolites (metadolerites and metagabbros) and green fibrous amphibolites (metapyroxenites).

Detailed petrographic and mineralogic study of the rocks reveals xenoblastic schistose aggregates of blue-green amphibole and calcic plagioclase in addition to minor epidote, sphene, quartz and opaque iron-ores in all the rocks. Relict basaltic, intergranular and sub-ophitic textures are occasionally seen. The modal composition of the rocks show above 60 per cent amphibole and below 35 per cent plagioclase. Optical properties like indices of refraction, 2V and extinction angles indicate soda-bearing calcic amphibole hastingsite and calcic plagioclase labrodorite with An 60-70 in most of the rocks, except in fibrous amphibolites, where the amphibole is a green actinolite intermediate in composition between actinolite and ferrotremolite. A relict occurrence of zeolite mineral scolecite is detected in a specimen of schistose amphibolite.

The unique assemblage of blue-green amphibole hastingsite and calcic plagioclase labrodorite in all the rocks ranging from metabasalts to metadolerites and metagabbros shows "amphibolite facies" of metamorphism, and indicates a uniformity in the metamorphic grade in the Kolar hornblendic rocks. The mineralogy, textural features and metamorphic grade show that the rocks are all amphibolites. The term "Kolar Amphibolite Series" is therefore proposed for the metavolcanic rocks of Kolar gold field, as this nomenclature helps to bring out both the composition of the rocks and their metamorphic character.

39. A preliminary note on the Charnockite from a bore-hole at Chowduar in Cuttack District, Orissa.

S. ACHARYA, Cuttack.

The author has undertaken to study in detail the several core-bits of charnockite totalling to a depth of five hundred feet. The bore-hole was put just on the bank of Mohanadi near Chowduar town. The succession in the bore-hole shows Laterite (recent) at the top, followed by Shale (Gondwana) and Charnockite successively. The nature of junctions could not be ascertained as the drilled cores were not available in full. The charnockite is melanocratic and porphyritic. Under the microscope it shows a poecilitic texture, the felspars (labradorite) being included in hypersthene. The felspars are euhedral, zoned and show well developed twin lamellae and combined albite and carlsbad twinning. The basicity of the labradorite as well as the number of phenocrysts increase towards the bottom. Hypersthene is primary and shows lamellar structure. The rock has also uniform mineral composition. These factors all indicate that magmatic differentiation is responsible for the formation of the charnockitic rocks of the area.

40. Mylonites of Deogarh, Mewar (Rajasthan).

K. P. RODE and P. V. SOMAYAJULU, Udaipur.

The paper deals with the study of mylonites running N.NE-S.S-W. as parallel bands two miles north of Deogarh in a crushed biotite, microcline-gneiss whose constituents show evidences of much crushing. An amphibolite band runs parallel to, and east of, the mylonite bands.

The mylonites simulate dikes intrusive into the gneiss. Megascopically they resemble rhyolites and quartzites. They are aphanatic, massive, structureless rocks with a sp. gr. of 2·8.

The mylonites present the following types.

(a) *The rhyolite type* with its cryptocrystalline groundmass shows banded flow structure, the flow bands swirling round quartz and felspar phenocrysts.

(b) In *the chlorite mylonite* the chlorite microlites which dominate the groundmass, wrap round felspar porphyroclasts. There is incipient growth of garnets in the chlorite, quartz mesostasis.

(c) *The massive aphanatic type* is conspicuous by its spherulitic texture, the radiating needles being made of pale chloritic stuff.

(d) The mylonite gneiss is intermediate between a pure mylonite and the biotite gneiss, the biotite in it having been drawn into interwoven threads. Obliteration of felspar twins is noted.

The mylonites are a product of cataclastic metamorphism of the gneiss in a zone of differential movement.

41. Magnetite-Biotite-Granulites from Nagpur District, Bombay.

NITIN KUMAR BASU, Kharagpur.

Magnetite-biotite-granulites occurring amidst the Sausar rocks in the Junawani Reserved Forest, Nagpur district, have been studied. Field occurrence of the rock types indicates that they are not paragneisses conformable with the Sausars as Fermor had assumed them to be. The present field study indicates that magnetite-biotite-granulite represent the oldest formation of the area over which the Sausars lie unconformably.

Laboratory study of the rock type has led the author to express some of his views on the mineralogenetic history. It seems to the present author that a rock of granodioriotic composition (which might have crystallised from a magma) under potash metasomatism suffered compositional change; hornblende converted into biotite, released calcium forming sphene or epidote around allanite core with development of microcline. Deep-seated metamorphism under high confining pressure and high temperature gave the rock a typical granoblastic texture and led to the formation of grossularite at the expense of calcium from anorthite molecule and also from epidote, released iron from epidote formed magnetite.

Lit-par-lit injection of granitic magma within the biotite-granulite (West, 1933) or (more probably) regional granitisation might have given rise to the streaky gneisses.

42. Study of the Archaean Parametamorphites of south of Darbha, Bastar Dt. M.P.

A. CHATTERJEE, Kharagpur.

Archaean rocks are exposed extensively south of Darbha, (18°48′ N Lat. and 81°52′ E Long.), Bastar Dt., underlain by the younger Cuddapaths.

The oldest rocks comprise of metamorphosed pelites with occasional psamitic variants and are referable to Crookshank's "Bengpal Series", The foliation direction generally strikes WNW-ESE curving widely towards the south. These rocks show a continuous increase in the grade of metamorphism towards the granite-gneiss body to the north, to which they actually grade through a wide belt of interesting group of migmatites. Zones of progressive metamorphic intensity delineated by the assemblages biotite-muscovite-schist, andalusite-mica-schist, garnet-sillimanite-gneiss for the pelites or their equivalents are established. Correlation between mineralogical and chemical composition of the parametamorphites obtained from chemical analyses of the type rocks reveals the attainment of equilibrium in response to PT conditions in some cases. In terms of facies classification, the development of Greenschist, Albite-epidote-amphibolite and Amphibolite facies of rocks is established.

Analysis of thermal gradients inferred from the zonation indicates the control of metamorphism with the invasion of the granite-gneiss.

Late shearing, occurring after the main period of metamorphism has resulted in post-crystalline-deformational fabric in the rocks; the development of lower grade mineral like chloritoid in high grade schists with consequent lowering and disequilibrium conditions of metamorphic facies.

43. Granulometric Studies of the Ortho-Quartzites of Cuddapah and Kurnool Systems around Kalava, Kurnool District, Andhra Pradesh.

T. C. BAGCHI and K. V. G. K. GOKHALE, Kharagpur.

Mechanical analysis of the representative samples from the Pulivendla, Banganapally and Panyam quartzites, has been carried out by the thin section method and the statistical size parameters are obtained from the corrected moments.

The graphical representation of the size-frequency values and the relationship between the phimean, phistandard deviation, phiskewness and phikurtosis, indicate the following:

1. The Pulivendla, Banganapally and the Panyam quartzites are all unimodal with prominent peaks in the ·16 – ·24 mm., ·24 – ·32 mm. and ·36 – ·44 mm. grades respectively.
2. The Pulivendla quartzites are poor to symmetrically skewed, moderate to well-sorted and very leptokurtic while the Banganapally quartzites are nearly symmetrical, medium sorted and leptokurtic to very leptokurtic. The Panyam quartzites are very well sorted, poorly skewed and are also leptokurtic.
3. The spericity values for the Pulivendla, Banganapally and Panyam quartzites vary from ·80—·96, ·77—·82 and ·72—·82 respectively.
4. The arithmetic and logarthmic size-frequency diagrams (Deoglas 1954) for all the three quartzites exhibit a truncated size frequency distribution, charateristic of marine deposits.

From the results of the mechanical analysis, coupled with the heavy mineral studies, the Cuddapahs have been interpreted as having been deposited in a transgressive marine environment and the Kurnools as belonging to a typical foreland facies.

44. A Note on Someshwar Phyllites, Mysore.

N. W. GOKHALE and R. V. THATTE, Dharwar.

The paper deals with the petrology of the Someshwar phyllites. This place is about one mile south-west of Dharwar town. Detailed mapping of the area was carried out on 4 inches to a mile scale. The phyllites are compact, partly crystalline and well jointed. These rocks merge imperceptibly into the argillitic country rocks. The argillites lack compactness and are non-crystalline, though both have identical strike direction (N40°W—S40°E). Two basic dykes traverse the phyllites but do not extend into the argillites. Thin sections of phyllite reveal that the rocks have undergone partial recrystallisation without any recombination. True schistocity is also not developed in them. The dykes appear to have produced this small patch of phyllites by contact metamorphism. Chemical analysis of argillites from around Someshwar has been carried out and it shows the argillites to be of sedimentary origin. The Someshwar phyllites likewise appear to have a sedimentary parentage.

45. A Note on some Dharwarian Rocks, N. E. of Dharwar.

P. C. HAZRA and Y. S. SAHASRABUDHE, Calcutta.

An interesting suite of Dharwar rocks comprised of greywackes, calc-chlorite-schists, banded hematite-quartzites and crystalline limestones, has been encountered forming a lenticular patch just south-east of Aminbhavi (15° 32′ :75° 4′) and about 7 miles N.E. of Dharwar (topo-sheet 48 M/2). The country rocks encompassing this lenticular patch consist of conglomerates, argillites and shales uniformly striking N.N.W.—S.S.E. and dipping W.S.W. at angles varying from 40-70 degrees.

The various rock types have been described in the paper and the differences between those forming the lenticular patch and the surrounding country rocks have been discussed. It is concluded that the lenticular patch probably represents a small inlier of the Middle Dharwars hitherto undifferentiated.

46. A note on the occurrence of clouded Feldspars and Corona structure in Dolerite Dykes of Auranga-Koel-Valley, Palamau, Bihar.

RAGHUJI VERMA, Ranchi.

In an earlier communication (1954) the author had reported the occurrence of a system of numerous dykes in this area. These dykes have variable composition, texture and were intruded at different periods. They comprise Gabbro, Norite, Pyroxenite, Hornblendites, and Dolerites.

The Dolerite dykes at KALAPAHAR and BAGHAUTA have been described in this paper. While the Kalapahar dolerite shows corona structure between olivine and plagioclase besides clouding in its feldspars, the Baghauta dolerite does not, although both are olivine bearing and of the same mineralogical composition. Clouding in feldspars has also been observed in several other dolerites. The occurrence of corona structure in basic rocks has already been reported by the author in 1956.

The phenomena of clouding in feldspar and corona formation are the result of metamorphism. Similar phenomenon has been reported by MacGregor, Poldervaart, Gilkey, Shand and others. study will go a long way in elucidating the metamorphic history of the present area.

47. Concentric Structures in the Alech Hills, (Kathiawar) Saurashtra.

A. M. MASCARENHAS, Londa, Belgaum.

The Alech Hills encompass an area of about 200 sq. miles about 30 miles NE of Porbandar (Saurashtra). The area presents similar interesting structural features as the well known examples of the Girnar Hills (Saurashtra) and the islands of Mull and Skye in Scotland. The author has mapped the entire area on 1 inch maps and the prominent structural features have been revealed although much more detailed work must yet be done. The area represents hypabyssal intrusions in the Tertiary volcanic rocks. The oldest intrusion in the series is a rhyolite which occupies an area of approx. 150 sq miles and which has intruded along a semi-circular fissure heading towards the south of the area. All the other intrusive rocks are found only in the elevations in the northern semi-circular portion surrounding the rhyolite mass. A granophyre ring-dyke is found as two separated converging outcrops concentric with the semi-circular rhyolite/trap contact. Circular faulting in the rhyolite mass and also tensional fissures caused by the intrusion of the granophyre has probably given rise to several rhyolite and felsite sheet intrusions the latter generally inclined towards the central rhyolite mass, The felsite intrusions lie along an arcuate line between the rhyolite mass and granophyre, their greatest concentration being between the separated outcrops of the granophyre ring-dyke. With a decreasing acidity of the magma the final phase of volcanic activity is represented by dolerites and basalt intrusions. The presence of a pyroxenite dyke has also been observed in the area.

48. Time of Formation and Kinematic Significance of Deformation Lamellae in Quartz.

KSHITINDRAMOHAN NAHA, Calcutta.

Garnetiferous quartz-mica-schists near the railway bridge on the Kharsoti *nadi* east of Ghatsila R.S. (86°29′ : 22°35′) show broad corrugations on bedding and schistosity, with extremely irregular profiles, leading to disharmonic folds and tectonic inclusions. The garnets show evidence of postcrystalline rotation; yet, irrespective of their position in relation to fold-arches and -limbs, the cracks in all the grains are parallel throughout the thin section (arranged normal to fold axis), proving their formation after garnets stopped rolling. Quartz is recrystallized, equant, and shows homogeneity of fabric in fold-apices and -limbs ,with non-selective quartz c-axis diagrams showing perfect girdles normal to the fold axis. Excellent deformation lamellae, and c-axes of quartz grains with deformation lamellae show two maxima in an incomplete girdle normal to the fold axis, symmetrically situated with reference to the cracks in garnets. Assuming that garnet cannot yield by gliding, (an assumption amply confirmed by snowball garnets with more than 180° rotation), the cracks are tensional, and the deformation lamellae nearly at 50° on either side of the tension axis thus coincide with the two planes of maximum shearing strain in the rock due to non-rotational strain in the last stage. And these lamellae, with orthorhombic symmetry must have developed well after the folds with monoclinic symmetry were formed.

49. A note on the Peptrofabric study of the Rhodopian Schists from Babichka Mountain, Yugoslavia.

B. B. S. SINGHAL, Kharagpur.

During the petrofabric study of the metamorphic rocks from Babichka mountain, it has been found that the quartz diagrams of these rocks show "f" type of girdle and well developed III type of maxima. According to this the schists from Babichka mountain are S-tectonites. From the fabric of the quartz diagrams it seems that quartz is formed due to recrystallization along S_1 and S_2 planes accompanied with compression and flattening (without rotation) by a stress acting at right angles to the original S (ab) plane. It has been concluded that the stress was from W or WSW direction i.e. parallel with the direction of Alpine orogeny in this area. It is just possible that the Hercynian movements were also in the same direction and that the Alpine orogenesis has overprinted its effects on the pre-existing ones.

50. Mineralogic changes produced by faults in Dolerite Dykes.

MOHAMED ZIAUDDIN, Calcutta.

Some mineralogic indications like silicification, epidotisation and amphibolisation are produced in dolerite dykes as a result of faultng in the southern extension of the Kolar Goldfields. The ophitic texture is obliterated and pyroclastic or nematoblastic textures have been developed. Bleaching of the rocks and increase in granularity are the other features noticed in the dykes. Since these mineralogic changes are localised and are confined to the portions of dykes affected by faulting, they are attributable to local cataclastic or dynamo-thermal metamorphism. These mineralogic indications noted in undisputed faults were later used as guides in regions where other evidences of faulting were either obscure or absent.

51. Petrography and Petrogenesis of Dykes of Mandwara Igneous complex N-W. of Abu Massif, Rajasthan.

K. P. RODE and T. R. SHARMA, Udaipur.

During the detailed geological mapping of Mandwara Igneous Complex comprising an area of nine square miles only, the authors have recorded one hundred and three dykes of varying thickness ranging from half a foot to 74 feet, besides a profuse ramification of thinner dykes and veins. The dyke rocks have developed a number of diverse petrological types from basic to acid members including alkaline types. The cores of many thicker dolerite dykes are composed of sodalite syenite, thus representing a composite character. Similarly a few dolerite dykes and Tachylite dykes exhibit a multiple character. All these dykes have very sharp contacts with the country rocks and have approximately uniform attitudes. Such structural and petrological features lead to suggest a mechanism of dyke formation through fissuring and later on healing of such fissures by ascending magmas as against the hypothesis of forceful emplacement into the country rocks.

52. An interesting Norite Dyke from Devalapur, Mysore District.

S. K. BABU, Madras.

The paper deals with petrological, mineralogical and petrochemical studies of an interesting norite dyke occurring near the village Devalapur. The average anorthite content of the felspar varies from 50% to 58%, and the twin laws observed are albite-carlsbad, carlsbad and albite law. Pyroxenes are represented both by the ortho- and clino-members. The latter group includes diopside and augite and the former one includes enstatite and hypersthene. These pyroxrnes occur poikilitically in the plates of plagioclase. Olivine occurs in glomeroporphyritic groups. It exhibits well developed reaction rims and double corona with its outer rim composed of bastite. Plagioclase shows intense clouding. Niggli values indicate that the dyke has not undergone any differentiation. To know the order of crystallisation of felspar and pyroxene (f) norm suggested by Barth (1936) was calculated, and it has shown that since the (f) norm of the dyke of Devalapur exceeds the value of 123, pyroxene crystallised earlier than the felspar. The foliation of the gneisses has facilitated the intrusion of the dyke along the foliation plane.

53. On a Relict Metadolerite Sill in the Granitic complex in the vicinity of Jhalida, Purulia District.

DILIP KUMAR SEN GUPTA, Kharagpur.

The paper deals with the occurrence of an isolated sill-like body of metadolerite within the granite gneiss in the vicinity of Jhalida (23° 22′ : 85° 58′), Purulia Dist. The outcrop trends nearly east-west with a varying width from 12 to 20 yds. The dolerite is melanocratic, medium grained and in places exhibits spheroidal weathering. The foliation and schistosity of the surrounding gneiss generally show east-west strike with vertical to steep dips towards north. The metadolerite has been traversed by replacement veinlets of the surrounding granitic rocks. Gradational contact between the metadolerite and the gneiss is well defined in the field. A few ghost like relics with partial felspathisation are met with in the gneiss. Near the contact of the latter, big felspar porphyroblasts with good carlsbad twinning (010) and cleavage (001) have been developed in the metadolerite. The microscopic examination reveals the presence of relict subophitic and intergranular textures. Towards the contact with the gneiss, the metadolerite shows marked increase of biotite and amphibole content. The poikiloblastic texture results from the incorporation of the earlier formed metamorphic minerals (chiefly biotite) which retain more or less the same orientation as the flakes outside the felspar. The myrmekite developed at the border of the potash felspar indicates a replacement origin.

The replacement veinlets of granitic rocks which transect the metadolerite, contacts which indicate a metasomatic invasion by the granitic rock and a marked felspathic border zone in the granitic rock against the metadolerite are some of the features which suggest that the metadolerite is older than the surrounding rock and is a relict which has escaped later regional granitization.

54. A Note on an Occurrence of Clastic Dykes in Burhai Gondwana Basin, Santhal Parganas, Bihar.

DIPANKAR NIYOGI, Kharagpur.

Clastic dykes with maximum thickness of three inches were found associated with rocks of Boulder Bed Stage of Talchir Series. The immediate host rocks were mauve-coloured siltstones and silt-shales and the dykes were made up of arkosic material with small angular fragments of mauve and green shales. A mass of penecontemporaneously deformed sediments was present nearby.

One of these dykes was found in direct continuity with a small conglomeratic lens within the silt-shales. It starts an inch thick and pinches out in an upward direction within a distance of four feet. The material of this dyke is the same as the interesticial matter of the conglomerate lens. This is clearly a case of injection of clastic material.

The phenomenon of injection of unconsolidated sediments has been discussed in detail.

55. Application of Sedimentary Petrographic methods to Geological problems.

M. POORNACHANDRA RAO and C. MAHADEVAN, Waltair.

In the scheme of research fostered by the Geology Department of Andhra University, study of coastal sedimentaries, beach sands, and marine sediments occupy a prominent place and sustained work by a team of workers for over 12 years has yielded valuable results. Correlation by heavy mineral suites of the sedimentaries in formations in the Circar districts has resulted in consigning the isolated rocks into recognised sub-groups and in the correction of the ages assigned to some of the formations. Study of the ocean bottom sediments upto continental shelf has revealed the sedimentation pattern bearing a relation not only to depth but also to the nature of the profile of the continental shelf. A most interesting result of the studies is the establishing of sea level oscillations along the east coast of India during Pleistocene glaciation.

Study of black sand concentrates along the beaches of this region has brought to light large reserves of economically useful minerals such as ilmenite, monazite, zircon, garnet, etc.

56. Petrological Investigations of the Rocks of Mohand near Dehra Dun.

S. K. BABU and P. V. DEHADRAI, Dehra Dun.

This paper deals with the petrological investigations such as heavy mineral study clays, carbonate minerals and mechanical analyses of the Siwalik rocks collected along Kherirau-Bongsot Section of Mohand. From the petrological studies it has been classified into three horizons marked by mineral markers—green tourmaline, hornblende and clays. This section bears close similarity to the Siwalik succession ot Janauri area Further the nature or assemblage indicate metamorphic and granitic rocks as the probable source rocks for these sediments and the deformation seen in some of the minerals e.g. kyanite, points that the source rocks were highly disturbed The complex nature of the heavy assemblage and light minerals show that the source was near. The similarity of these rocks to the Siwalik succession of Janauri though separated over a stretch of 250 miles show that the source rocks were similar, and conditions of deposition were practically the same.

57. Heavy Mineral Assemblages of the Cuddapah and Kurnool Formations around Kalava, Kurnool District, Andhra Pradesh.

T. C. BAGCHI and K. V. G. K. GOKHALE, Kharagpur.

The paper represents a comprehensive account of the heavy mineral assemblages of the Cuddapah and Kurnool formations around Kalava (Latitude 15° 37′, Longitude 78° 12′), Kurnool District. In the area, the Cuddapah system is represented by Vempalle limestones, Pulivendla quartzites and Tadpatri shales, and the Kurnool system by the Banganapally conglomerates, orthoquartzites, Narji limestones, Auk shales, Panyam quartzites, Nandyal shales and Koilkuntla limestones.

Statistical analysis of the heavy mineral assemblages together with the detailed study of grain morphologies have been carried out to investigate the probable source rocks, transportation and depositional history of the sediments.

Even though the overall heavy-mineral assemblage is quite uniform, each stage is characterised by the predominance of an index mineral. The type of species of the different stages are given below:

Nandyal shale ...	No characteristic assemblage
Panyam stage ...	Yellow garnet (60-74%)
Auk stage	Kyanite (60-74%)
Narji stage	Garnet (23-27%)
Banganapally stage ...	Tourmaline of different varities (Authigenic 45-50%)
Tadpatri stage ...	Dusty zircon with inclusions of accicular rutile (13-17%)
Pulivendla stage ...	Well rounded striated rutile (35-44%)
Vempalle stage ...	Pink garnet (7-13%)

The Comprehensive heavy mineral frequency graph brings out the sharp unconformity between the Cuddapah and Kurnool systems and possible minor breaks in between the stages. These breaks may not strictly imply lapse in sedimentation but rather indicate constant shift in source rocks.

The assemblage in Cuddapah system is rather restricted to the most resistant types, suggestive of their derivation from reworked sediments.

The heavy minerals in the Kurnool system are more varied and are interpreted as having been derived partly from reworked sediments and partly from metamorphites. The cross bedding directions indicate a prominent western source, possibly the Dharwars.

58. The Rarity of Garnets and Ferromagnesian Minerals in the Red Loam Formation of S.W. India.

K. KUNJUNNI MENON, Trivandrum.

Laboratory examination of the heavy mineral assemblage of red loam samples collected from the formation between Trivandrum and Kanyakumari shows that :— (1) the assemblage are essentially similar regarding mineral species, (2) each assemblage consists of a small number of minerals having considerable stability, (3) garnets and ferromagnesian minerals, scarcely represented though these commonly occur in the source rocks.

Field observations confirm the instability of garnets and ferromagnesian minerals subject to decomposition under tropical conditions. However, these minerals are highly stable when subjected to mechanical weathering as observed from their occurrence in detrital deposits along the beach.

The rarity of these minerals in the red loam may be significant in tracing the manner of origin of the formation. Two views seem suggestive : The red loam formation resulted from the reworking of *either* the products of chemical weathering of the archaean crystalline rocks, the garnets and ferromagnesian minerals having been lost during lateritisation, *or* the products of mechanical weathering of the same rocks and that garnets and ferromagnesian minerals which originally were present in the red loam were gradually eliminated by solution during post-depositional period.

59. On the Rocks of the Kodadongri Area: A study in heavy mineral correlation.

SRIPADRAO KILPADY and G. G. DESHPANDE, Nagpur.

The paper is an attempt to assign the rocks exposed at Kodadongri—a place 14 miles north of Nagpur, to their proper stratigraphic position by comparing the heavy mineral suite of these rocks with those of the Talchirs of Korhadi and the Kamthis of Patansaongi which occur in close proximity. Blandford who studied this area was sure that of the Korhadis belonged to the Talchirs but expressed doubts about the actual position of the Kodandongri rocks. The heavy mineral assemblage of the Kodadongri rocks is very much similar to that of the Kamthis of the Patansaongi and Silewada areas. All these are flooded with Iron ores, and are associated with zircon, rutile, epidote, tourmaline, kyanite, sillimanite, piedmontite etc. This assemblage differs from that of the Korhadi Talchirs, which is a garnet predominating one the other minerals being iron ores, zircon, rutile, epidote, tourmaline, sphene, piedmontite etc. A comparison of these assemblages indicates that the Kodadongri rocks do not belong to the Talchir stage but form an isolated patch of the Kamthis. The suites also suggest that the rocks from all these localities owe their parentage to the rocks of Sausar series.

60. Mechanical Analysis of the Lower Gondwana Sediments of Giridih Basin, Bihar.

C. NARASIMHA RAO, Kharagpur.

The Giridih Basin (24°13′—24°14′; 86°15′—86°17′) consists of two chief stages, the Talchir and the Karharbari. The paper presents the results of the mechanical analysis of sandstones sampled regularly along and across the strike to bring out the significant changes in the size parameters in time and space. The available statistical data do not show any abrupt changes or uniform variation in time and space. It should be noted that the Talchir sandstones are found mostly in the uppermost horizons in the Talchir stage and could be easily mistaken for Karharbari but for their green colour. Even though the significance of statistical measures in terms of environmental conditions is doubtful it appears that there were no major changes in the environmental conditions of deposition during the upper Talchir and Karharbari periods.

61. Granular Variation in Heavy Minerals—a Study in Barakar Sandstones of South Karanpura Coalfield.

INDRANIL BANERJEE, Calcutta.

In the present study, a comparison has been made ebtween the size-distribution of the sand fraction (recalculated to 100%) and that of the entire heavy fractions of a suite of Barakar sandstone samples from eastern part of the South Karanpura coalfield, Bihar (23° 37′ to 23° 42′; 85° 24′ to 85° 28′). This has revealed that the heavy fraction has always a smaller average diameter and a better sorting value. A linear relation between the sorting of the two fractions exist but no such relation exists between the corresponding median sizes, possibly due to difference in sorting in two fractions and also the variable size and sorting of the component minerals.

A comparison has also been made between the distribution of light minerals and that of each component of the heavy suite, namely, tourmaline, zircon, opaques (magnetite, ilmenite and limonite) and muscovite. Zircon size-distribution in all the samples shows a similar form with fixed average diameter and dispersion value suggesting that sorting processes which modified the sand portion are inoperative on zircon and the mineral has more or less the same distribution as in the source rock.

The average diameter and sorting of tourmaline and the opaques show a close linear relationship with those of the sand, signifying a hydrodynamic behaviour similar to quartz. The median diameters of muscovite show no correlation with that of the sand but the sorting value has a rough correlation, suggesting that mica, due to its flaky habit, behaves differently during deposition from equidimensional minerals.

From a consideration of the parallel behaviour of all the minerals and invariable nature of zircon size-distribution it can be suggested that a single grade containing the median size of zircon (3·25) will be suitable for heavy mineral comparison between samples. Such a grade is the 0·125-0·062 mm. grade.

62. Reflections on the Conventional Method of Analysis.

AMITAVA DUTT, Giridih.

Chemical analyses of successive sub-stages of a system often indicate participations of constituents in varying degrees. Thus comparing two successive substages some of the constituents appear to be higher or lower in percentages leading one to the conclusion that these constituents were either added or subtracted. Since chemical analyses indicate only proportion of oxides the above observations will be erroneous. Quantitative decrease or increase of a single constituent may upset the entire proportions. If, however, the constituents which remained constant in two successive sub stages, can be determined, the extent to which the other constituents have been affected may be ascertained.

The following method is suggested

$\frac{a_x - b_x}{a_x} \times 100$ where a_x and b_x represent a particular species, at two successive sub stages. When two or more constituents indicate identical percentages they are to be considered as constants. The constants must bear the same sign positive or negative. Difference upto 1·2 may be tolerated. Such fixed constituents are expected in all natural processes. The method will fail when two or more different sets of constants are present or all the constituents have been affected, which is extremely rare in natural processes of rock formations. Various well known systems have been discussed in the original paper.

63. On the Chemical Composition of the Basti Meteorite.

P. D. MALHOTRA, Calcutta.

A stony meteorite fell in a village in Basti District, U.P. on the 24th March, 1955. A piece weighing about 650 grams was received in the Geological Survey of India from the Director, State Museum, Lucknow. Small fragments from the meteorite were crushed and separated by means of a magnet into attracted and unattracted portions. These have been used in the present study for quantitative chemical analysis and qualitative spectrochemical analysis for minor elements. The chemical composition of the meteorite is as follows:

Fe 2·20, Ni 0·12, Co 0·01; Fe 0·17, S 0·11; SiO_2 39·01, TiO_2 0·10, Al_2O_3 1.31, Cr_2O_3 0·47, Fe_2O_3 trace, FeO 16·88, MnO 0·38, CaO 2·09, MgO 36·19, Na_2O 0·15, K_2O trace, P 0·01, H_2O 0·17, Total: 99·37.

Elemental carbon is also present but has not been determined.

The metallic and silicate phases were spectrographed using anode exitation. Traces of Li, Ba, Sr, V, Sc, Cu, Pd, Zr, Mo, and Pt were detected.

This meteorite has been provisionally identified as an achondrite. In view of the rarity of such meteorites, a detailed study of its mineralogy and chemical petrology will be presented elsewhere when complete.

(v) Economic Geology

64. Structural Control of Gold-bearing Lodes in Kolar Gold Field, Mysore.

S. NARAYANASWAMI, MOHAMMAD ZIAUDDIN, and A. V. RAMACHANDRA, Calcutta.

Detailed structural mapping in the Kolar Gold Field in Mysore indicates that the rocks of the Kolar Amphibolite Series are folded into an isoclinal syncline overturned steeply to the east, with the axis plunging northward at moderate angles of about 30°-40°. A remarkable feature of the Kolar structure is the "cross-folded" nature of the folds. The original North-South striking synclinal axis has been partly refolded about a NNW-SSE to NW-SE axial trend, giving rise to the present configuration of the schist belt which shows branching and westward shifting of the belt at intervals southward.

The drag folding along the Champion lode and also on the sulphide-bearing Western lodes, the en-echelon pattern of ore-shoots and the en-echelon pattern of individual quartz veins and stringers within the ore-shoots reveal a remarkable structural control in the formation of the gold-bearing lodes in the field. The lodes are localized within schistose amphibolites along North-South trending strike-fault fissures on the two limbs of the synclinal structure. Drag folding of these fissures during subsequent cross-folding of rocks seems to be the major structural control for the formation of lodes and occurrence of ore-shoots at intervals along the strike. Localization of quartz in the noses of folds and localization of gold in ore-shoots in these areas may be related to dilation of the fissure openings along the axes of folds which have facilitated ingress of mineralizing solutions. The parallel, en-echelon pattern of quartz veins and stringers within the ore-shoots, indicates shear fracturing of the nature of fracture cleavage in such highly folded areas. The left-handed overturn of drag folding, shear fracture patterns and the northerly pitch of ore-shoots along the Champion lode in all the mines and along the sulphide-bearing Western lodes in Champion Reef and Mysore mines have been produced by west block north and up movement in relation to east block south and down movement. The opposing right-handed fold and shear fracture patterns and southerly pitch of ore-shoots along the Western lodes in Nundydroog mine suggests west block south and up movement in relation to east block north and down movement. The above structural pattern of shear fractures and pitch of ore-shoots have an important application in the exploration and development of gold-bearing lodes in the Kolar Gold Field.

65. Ore Mineralisation and Wall-rock alteration of Gold-bearing Lodes in Kolar Gold Field, Mysore.

S. NARAYANASWAMI, M. KRISHNAMURTI and K. APPAVADHANULU,
Calcutta.

The gold-bearing lodes of Kolar Gold Field consist mainly of gold-quartz lodes belonging to the Champion lode system and sulphide-bearing Western lodes, namely McTaggart East, McTaggart West and Oriental lodes. The lodes form quartz vein-zones composed of a series of parallel, en-echelon veins and stringers of highly sheared, bluish-grey to white, vitreous quartz, traversing through a zone of highly altered, recrystallised and mineralized wall-rock containing silicates diopside, hornblende, epidote, biotite, etc., and minor sulphides pyrrhotite, arsenopyrite, galena, pyrite, chalcopyrite and sphalerite. The Western lodes contain a greater proportion of metallic sulphides upto 10 or 15 per cent of the lode matter, occurring as layers alternating with quartz stringers and silicate layers. Gold occurs within quartz, silicates and sulphides. The most characteristic effect of the lodes on the amphibolitic wall-rock is the brown micaceous wall-rock alteration which extends to widths of upto 50 feet on either side of the lodes. Within the highly sheared, schistose, altered and recrystallised wall-rock within the lode, three distinct zones of alteration are distinguished on either side of quartz veins and stringers, (1) a thin diopside casing at the immediate contact of the vein quartz, followed outward by (2) a zone of epidote and hornblende, and (3) a thicker zone of biotite mica. The progressive zoning in the altered wall-rock indicates a gradually decreasing temperature and pressure and increasing hydroxyl molecules in the hydrothermal solutions which resulted in the crystallisation of increasingly hydroxyl-bearing silicates epidote, hornblende and biotite.

Introduction of vein quartz accompanied by metasomatic alteration and re-crystallisation of silicates, followed by replacement of silicates and quartz by metallic sulphides and finally introduction of gold seem to be the sequence of mineralization. The association of vitreous and glassy quartz with diopside, hornblende, epidote and biotite, and the presence of pyrrhotite, arsenopyrite, pyrite, magnetite and ilmenite, affix the Kolar gold lodes to the highest temperature hypothermal ore deposition known in the world with affinities towards pyrometasomatic mineralization.

66. Ore Mineralisation in Kolhans South of Chaibasa, Singhbhum, Bihar.

MIHIR KUMAR BOSE, Calcutta.

Fracture zones trending dominantly NE-SW, in the Kolhan series, south of Chaibasa (22°33′ :85°28′) have been mineralised. Mineralisation is more frequent in the competent Kolhan sandstone than in shale and also along sandstone-shale lithologic boundary. The mineralising solution was in the first phase ferriferous in nature and formed such minerals as, limonite, goethite and specularite ; these were followed by a phase of manganese mineral formation as psilomelane, pyrolusite and its idiomrphic form in a paragenetic order. The most interesting textural relation is the core and rim replacement of goethite by psilomelane. The fibrous goethite is characterised by the association of fine plates of hematite with reflectance of 23% in green light in air. The goethite-hematite association suggests a temperature of about 150°C during mineralisation. Reflecting powers of fibrous goethite in green light in air, are 17·5% and 19·3%, respectively along and across the fibre direction. The present assemblage of ore minerals suggest strongly a replacement origin for them. The ore minerals always show a replacement relation to the primary mineral quartz of the country rock. The source of metalising solution is uncertain. But the gonditic rocks near Tekorhatu (22°29′ :85°48′) as described by Dunn (1939) were found from field and laboratory evidences to be quartzites, produced by shearing and silicification of Kolhan sandstone.

67. A Note on Hematite—Molybdenite Mineralisation in Limestone at Jhinkpani, Singhbhum District.

BANKIM MUKHERJEE, Jadavpur, Calcutta.

Specular hematite occurs as an isolated deposit, associated with quartz vein in crystalline limestone, at Jhinkpani, Singhbhum district. The few samples of hematite were polished and studied under the ore-microscope which revealed the presence of hematite and molybdenite. The two minerals were conclusively identified by optical characters, etch reactions and reflectivity measurements by Berek's Slit Microphotometer in green light. The hematite occurs as streaks and needles and is the predominating mineral. Reflectivity is 25·8 per cent. Molybdenite on the other hand occurs disseminated in hematite as a few tabular crystals, characterised by intense reflecting pleochroism, strong anisotropism, undulatory extinction and high reflectivity—36·1%. Twinning present, parallel to (0001).

The hematite and molybdenite both show textures which are developed due to deformation. The hematite shows definite schistose texture. The molybdenite shows effects of shearing movement and develops translation twinning or false cleavage on a microscopic scale due to slip and parallel displacement.

As to the mineral paragenesis, the hematite is formed much earlier and the molybdenite seems to have been mineralised along fissures in hematite. The molybdenite occurs rather disseminated along the strike of the schistose hematite some what like 'fahlbands'.

68. The Geology of the Bubani Emerald Mine near Ajmer, Rajasthan, with a note on the origin of Emerald.

T. C. BAGCHI, Kharagpur.

The Bubani emerald mine situated 12 miles E.N.E. of Ajmer, lies in the Ajmer-Merwara emarald belt trending N.N.E.-S.S.W. The country rocks in the region consist of metamorphosed pelitic and igneous rocks. These rocks, which have mostly been injected *lit-par-lit* by the pegmatites, are extensively silicified and tourmalinised with the development of schorl rock.

Hexagonal crystals or anhedral grains of emerald occur in pockets or are as desseminated in the actinolite and talc schists in the vicinity of pegmatites.

Petromineralogical and structural studies of the rock types in the mine area suggest that the emeralds had, been formed by the permeation of beryllium rich solutions along structural and weak planes in schists, which preceded the introduction of the main pegmatitic solutions. Evidences indicate that tourmaline was not only introduced earlier than the pegmatitic minerals but continued to grow upto the last stage. Judging from the grain size of the pegmatitic minerals it seems probable that the main pegmatite was injected at a stage when the residual magmatic solutions had become deficient in volatile constituents.

Arguments have been put forward to suggest that the pegmatites are genetically connected with the Erinpura Granite and they really represent its residual magmatic solution and are thus post-Erinpura in age.

69. Studies on the Field ond Ore microscopic characters of the iron and manganese deposits of Jabalpur District, M.P.

V. S. DUBEY, A. K. BHATTACHARYA and UMA SHANKAR, Varanasi.

Iron and manganese ores occur in the hillocks in Gosalpur, Sirauli, Agaria and Deonagar within 15 miles of the town of Sihora between Katni and Jabalpur, Haematite and limonite form the bulk of the iron ores, while the manganese ore is psilomelane.

The haematite beds occur mainly as pockets and lens-shaped bodies along and across the general trend of the deposits of laterite, interbedded with thin layers of phyllite. The psilomelane is also generally found as pockets intimately associated with haematite in laterite. It is also known to occur as thin bands and streaks in phyllites in the western part of the Agaria hillock.

Samples taken at random from different pockets were examined. Under the ore-microscope the haematite shows the usual properties, but owing to large amount of admixed impurities, reflectivity, reflection pleochroism and anistropism are somewhat reduced. Intimately intergrown psilomelane is found in some sections. Psilomelane shows the usual properties but has retained its original gel character and is so faintly anistropic. It shows various evidences of deposition from a colloidal solution.

Field and microscopic evidences point conclusively to the secondary nature of these deposits. Probably haematite with little manganese was deposited interbedded with phyllite and this on weathering has given rise to lateritic hills. The manganese has been removed in the form of colloidal solution and was precipitated in the form of psilomelane, in the cracks, fissures of phyllite and iron ores.

The manganese deposits yield only a few hundred tons per year and there is little prospect of any big deposits found in this area.

70. Barite in Anantapur District, Andhra State.

R. THIAGARAJAN, Calcutta.

Barite occurs in the form of veins in the region between Mutssukota and Venkatampalle. Other occurrences of minor importance are near Kondampalle, Varadayapalle, Nayanipalle, Sanjivapuram, Karnapudi and Madugupalle. The veins follow, in general, certain definite lines of fracture in the limestones and shales of the Vempalle stage and quartzites and quartzite-conglomerates of the Pulivendla stage, Cuddapah system. In the light of field observations on the mode of occurrence of the barite veins, and their character and close association with basic igneous rocks, and the presence of milky white quartz, fluorite and chalcopyrite with barite in the veins, the author is of the opinion that barite, in this region, is of epithermal origin brought up in solution in the form of $BaSO_4$ in emanations from the basic igneous rocks and deposited in the form of true fissure veins in zones of fracture and brecciation.

71. Occurrence of Talc in Jaipur and Sawaimadhopur Districts, Rajasthan.

R. THIAGARAJAN, Calcutta.

Talc occurs in the form of veins and lenses in quartzites near Khawa and Gijgarh, in Jaipur district, and in grits near Dhaota, Dhwain, Rajauli, Garhi and Morra in Sawai Madhopur district, Rajasthan. The quartzites and grits belong, according to Heron, to the Alwar Series of Delhi system.

The talc bands, in general, show a distinct discordance to the plane of stratification of the grits and quartzites. The latter contain impregnations of talc and some chlorite. The formation of talc is, therefore, post Alwar in age.

Some proportion of serpentine, magnetite and chlorite occur in association with talc. Carbonate minerals are, however, absent. The author is of the opinion that talc was formed by alteration, under conditions of low temperature and pressure, of magnesian minerals of an intrusive ultrabasic igneous rock.

Intrusive rocks which could be put, in age, later to intrusion of the ultrabasic rock to account for the alteration of the ultrabasic rock to talc, are not known to occur in this region. Introduction of chlorite in quartzites and talc in grits and the sericitisation of felspars in the grits, indicate a total permeation of magnesian rich solutions from the ultrabasic intrusive. It is therefore probable that the alteration to talc of the magnesian minerals of the ultrabasic intrusive, was effected by solutions from within the ultrabasic intrusive.

72. Ilmenite Deposit at Barna, Kishengarh State, Rajasthan.

T. C. BAGCHI and A. MOOKHERJEE, Kharagpur.

The Ilmenite lode in Barna, south-east of Kishengarh (26° 34′ : 74° 52′) occurs in biotite granite-gneiss as a hydrothermal fissure vein with a high northernly pitch and is concordant with the foliation strike of the country rock. A mineral zoning within the lode is conspicuous, although it does not show a strictly bilateral symmetry. The walls, particularly the hanging wall side is studded with biotite evidently assimilated and recrystallised from the adjacent country rock.

The mineralogy is characterised by high and low temperature mineral association. Ilmenite is the only important metallic mineral, with fine ex-solution plates of haematite along (0001) planes. Others are goethite and lepidocrosite, intimately mixed up, forming septal box-work around malachite grains. Rest of the minerals are α-quartz, converted from β-variety (Wright & Larsen; Menn.), pistomesite ($\epsilon = 1{\cdot}625$), calcite, malachite and crysocolla.

Mineral paragenesis indicates a progressive cooling without any appreciable oscillation of temperature. The cellular and foggy nature of the limonite and absence of vugs and limonite halo strongly suggest an indigenous origin of limonite, although no sulphide was encountered upto the depth of 35′, so far reached.

The coexistence of such high temperature minerals as β-quartz and ilmenite with the low temperature copper carbonates, as well as the co-existence of geochemically dissimilar elements like Copper and Titanium, is difficult to explain. There is however no evidence of "resurgence". Thus we are left with two possibilities :—

1. The mineralisation took place through a protracted period of cooling during the late stage of which the solution somehow became comparatively enriched in copper; in which case a low-lying sulphide zone may be expected.

· 2. The Copper bearing solution, may be entirely unrelated genetically, was introduced later along the lode which was obviously a very favourable structure for its localisation.

73. On the Occurrence of Niobium in Nepheline Syenites and Bauxites of India and its Geochemical and Economic Significance.

R. C. SINHA and B. D. TEWARI, Varanasi.

The occurrence of niobium in the nepheline syenites of Girnar and Kishengarh and bauxites of Bihar and Madhya Pradesh has been reported. Both spectrochemical and spectrographic methods have been used for the analysis of the samples and determination of niobium percentage in them. It has been found that the niobium content of these bauxites is sufficiently high so as to justify its extraction as a by-product during the bauxite processing for alumina. The results on the samples of nepheline syenites, though encouraging, require more investigation before any concrete suggestion for their future treatment for niobium is put forward.

The geochemical behaviour of niobium and its mode of occurrence in the various types of igneous rocks is discussed. It has been pointed out that a knowledge of the rare-element distribution in rocks and minerals can be taken as important guide in petrogenetic problems. On the basis of the observed enrichment of niobium in the bauxite samples it has been concluded that their origin from basic igneous rocks, as suggested by Fox, is highly improbable and, on the other hand, the possibility of their being the products of acid and alkalic rocks by alteration and weathering is very strong.

The present work embodies only the results of some of the occurrence of nepheline syenites and bauxites of India.

74. Occurrence of Vermiculite in the neighbourhood of Tatisilwai, about 8 miles East of Ranchi town—its properties and economic utilisation.

S. DEB, Jadavpur, Calcutta.

During the geological prospecting of barites veins in the neighbourhood of Tatisilwai about 8 miles east of Ranchi town, several pegmatite veins were encountered traversing the country rocks consisting mainly of Chotonagpur granite gneiss. Some of the pegmatites contain small flakes of muscovite, quartz and felspar but most of them containing principally quartz show, at the contact of the country rock, an interesting association of vermiculite—a hydrated micaceous silicate, which is supposed to be the alteration product of biotite and phlogopite mica. The mineral is used principally for thermal insulation and also for acoustical and dehydration purposes. Several prospecting trenches have been dug at the contact of the quartz dikes and the granitic country rock. Most of the trenches gave fairly good indications of a rich concentration of vermiculite, but the deposits seem to be discontinuous and pockety in character. Quartz—vermiculite zone consists of pockets, narrow seams or sometimes a sheath of vermiculite on either side of the veins. Vermiculite is flaky and ranges from light brown to dark brown in colour.

Exfoliation tests have been carried out with the samples drawn from different exposures by heating the mineral to 1000°C in an electric furnace, the volume expands 12 times the original dimension.

Optical properties, sp. gravity, coefficient of thermal conductivity and co-efficient of sound absorption tests have been determined and its usefulness as heat and sound resisting material has been proved experimentally.

As regards its origin, it is probable that the vermiculite deposits are formed as an alteration product of biotite mica by the hydrothermal action caused by the pegmatitic intrusives.

It is difficult to have an idea about the reserve of the mineral by the study of a few prospecting trenches. Where the deposits are fairly continuous along the quartz-veins for more than 200 to 300 yds., one can get about 5 to 6 maunds of vermiculite after digging upto a depth of about 10 to 12 feet from the surface. Below 15 ft. the rocks gradually become hard, compact and massive, when more intensive method of mining is necessary to remove the quartz veins and the hard granite—gneiss.

75. Vermiculite—A Unique Occurrence.

P. G. DOWIE, Madras.

While prospecting for ceramic raw materials for a well-known firm in South India in August 1953, a very interesting occurrence of vermiculite was observed near Kadavur (10°35′ 30″ 78°11′ 30″) in the Kulitalai taluk, Trichinopoly district. The occurrence is unique in that the crystals are large, ranging from 1″×1″×⅛″ to 1″×4″×¼″ and that these occur sporadically in altered pegmatite very similar to normal occurrence of muscovite or biotite crystals. The pegmatite occurs in felspathic-quartz gneiss containing minor proportions of hornblende and biotite, quartzites, quartz schists and other para-gneisses and schists which form the country rock. The place of occurrence is just outside the "Anorthosite—Gabbro Mass of Kadavur" described recently by A. P. Subrahmanium in the Geological Magazine. The paper describes also the topographic setting of the neighbourhood, the preliminary geology, structural features and the probable origin of the vermiculite.

76. On the occurrence of a manganese deposit in Midnapore district, West Bengal.

K. L. DAS, Howrah.

This is the first time that manganese has been discovered in West Bengal. The author explored a very extensive area and found only a few acres of land as ore bearing. The geological formations of the area belong to metamorphics. Manganese occurs in phyllitic shale and quartzite as irregular bodies, thin veins and stringers. In some places lateritoid deposits were also noticed. The quality of the ore is generally of low grade.

77. On Radioactive Uraniferous Iron Oxides.

M. D. KARKHANAVALA, Bombay.

A study has been made of uranium-bearing iron oxides from the shear zone of Bihar, with particular reference to the nature of the association of uranium with magnetite and hematite. In veins where none or very little hematitization has taken place, the primary magneite and uraninite coexist. Where it has taken place the uranium is very intimately associated with the hematite, probably as a very limited solid solution. A sample of hematite containing uranium equivalent of 0·15%U_3O_8, was found to be metamict, the reconstitution of which was established by X-ray and differential thermal analysis methods. It is believed that a primary oxidising solution containing uranyl ions caused the oxidation of the ferrous hydrosol to magnetite and the simultaneous precipitation of uraninite. A later stage oxidising solution or normal agents of weathering converted the magnetite to hematite and the uraninite to probably U_3O_8 or UO_3, a small amount of which was then somehow taken up in the hematite lattice, the rest being converted to distinct secondary uranium minerals.

78. Vertical Magnetic Anomalies in the Kodur Manganese Belt.

B. S. R. RAO AND V. L.S. BHIMASANKARAM, Waltair.

In the present investigation the Kodur manganese belt consisting of Garividi, Kodur, Duvvam and Devada mines in Srikakulam district was experimentally surveyed with a vertical magnetometer. About 1200 magnetic stations were laid out covering the above areas. It was generally noticed that very high anomalies of both positive and negative signs were observed over some of the existing manganese-ores. The causes for the negative anomalies may be due to partial or complete reversal of the direction of high remanent magnetism which the ore-bodies possess. Further it was observed that both types of manganese-ore deposits giving rise to high and low magnetic anomalies contained similar percentages of manganese and iron. This discrepancy is probably due to the heterogeneous nature of the widely ranging manganese mineral assemblages of the ores.

(vi) Ground Water

79. A Note on the Groundwater conditions of the area around the Calcutta City, West Bengal.

G. C. CHATEERJI & A. B. BISWAS, Calcutta.

The paper deals with the groundwater conditions of the area around Calcutta city with special emphasis on its chemical quality and character. The city of Calcutta and its environs are situated on the low lying flood plains of the Hooghly river, and are underlain by widespread and very thick alluvial deposits of Quarternary age. These deposits consist, at least to depths recently drilled, of a succession of clay, clay with *kankar*, sandy to silty clay, silt and fine to coarse sand. Locally thin beds of gravel and lime-cemented sands are occasionally present within unconsolidated sand beds. Examination of drill cuttings recovered from the boreholes drilled in the area reveals the presence of an upper clay bed with intercalation of peat ranging in thickness from 40 to 150 feet below land surface. This clay bed is generally more thick in the central and northern parts of the city than in the south. It is underlain by sand which progressively increases in proportion with depths. The sand horizon occurring immediately below the upper clay bed is usually yellowish to light brown in colour and is gradually replaced at depths by grey coloured sand.

For heavy development of groundwater for industrial and municipal uses aquifers in the 300-700 feet depth range where well graded and saturated sand occurs, have been tapped. Available pump-test data indicate that the yield from large diameter tubewells generally ranges from 330 to 880 g.p.m. Water in this zone is under artesian pressure, and usually rises to within 15 to 20 feet below the land surface.

The quality and character of groundwater of this area varies very rapidly both vertically and laterally. The water is mildly alkaline in reaction, the maximum pH recorded being 7·8. It is quite hard,—the total hardness ranging from 300 to 1240 ppm. Hardness, both of bicarbonate and non-bicarbonate type is found. So far no regular pattern in their distribution has been worked out. The chloride content ranges from 55 to 1385 ppm. Both ferruginous and non-ferruginous types of water occur in the area under study with total iron content varying from 0·016 to 6·0 ppm. In all ferruginous water containing more than 0·3 ppm. of Fe, the iron-bacteria usually develops giving rise to 'red water' trouble. Water with high iron content and total hardness will require proper treatment to render them suitable for domestic and industrial uses.

80. Groundwater Supply in the Budelkhand Granitic country.

S. C. AWASTHI, Calcutta.

In the Bundelkhand granitic country the vital problem is that of providing steady water supply. Exploitation of the ground-water in the area has so far been for the domestic use only. The rainfall in the area is capricious and steady even distribution being rare. The average annual rainfall is about 40 inches. A major portion of the rainfall goes to waste as surface run-off and very little percolates to replenish the ground-water. In fact, there is no continuous water table and ground-water occurs in a number of disconnected pockets. Normally, each pocket has its own catchment area, often demarcated either by the exposure of the bed rock, reefs or dykes. Ground-water mostly occurs in the alluvium at its contact with the bed rock. Most efficient method of developing the groundwater resources in the area would be by sinking large diameter dug wells. Tube wells have very remote chance of success in this tract except in such zones where the bed rock is considerably weathered.

B. GEOGRAPHY

(i) Geomorphology

81. Geomorphology of the Lowland Tract of Vishakhapatnam District.

Mrs. K. SITA, Bombay.

The Visakhapatnam Lowlands comprise part of the east coastal plain. It comprises a belt of country about 105 miles long and 32 to 34 miles broad, bordering and running parallel to the coast in a northeast-southwest direction. The land is almost every where less than 1000′ above mean sea level, but isolated hills rise steeply to heights ranging from a few feet to 2000′ and provide a diversity of relief. The region is largely underlain by crystalline rocks, mainly Khondalites, Charnockites and granites.

A morphometric analysis of the area using the Altimetric frequency curve and superimposed profiles reveals the existence of several erosion platforms, which probably represent former peneplains. A longitudinal profile along one of the rivers reveals knick points, two of which correspond with the erosion levels.

A study of the coastal features indicates a number of clear wave-cut erosion platforms in some areas which occur well-above the present sea level. These together with the stacks, caves, etc. suggest that changes of sea level have taken place.

The hills are distributed in a series of ridges which help to divide the area into physiographic units.

82. Physiographic Regions of the Ranchi Plateau. A Geomorphological Study.

KANANGOPAL BAGCHI and ASHIT KUMAR SEN GUPTA, Calcutta.

Ranchi Plateau has been divided into four physiographic regions. (1) The 'Pat' countries of the Western Ranchi Plateau, (2) the Central Ranchi Plateau lying between 2100 and 2300 feet, (3) the Southern dissected country and (4) the Upper Damodar Valley.

The eastern escarpment of the 'Pat' countries forms a drainage divide in the Ranchi Plateau. Consequent streams flow down the original slopes of this escarpment and get discharged in the North Koel and South Koel rivers in the west and east respectively. The peculiar character of flow of the Dhardhari Nadi has been discussed in the paper.

In the Central Ranchi Plateau monadnocks are very important geomorphic features. These have been classified into three types, the conical Hat topped and Dome shaped. The waterfalls of the Central Ranchi Plateau have been treated with. A few points for further investigation of the terrace-like formations on the Subarnarekha, South Koel rivers and their tributaries have been placed by the authors in order to make an exact conclusion in classifying them as river terraces or bad lands.

The geomorphology of the Southern dissected country has been discussed in relation to its structure. Evidences of bevelling of the monoclinal ridges have been provided with the help of geological sections.

Four types of land forms have been identified in the Upper Damodar Valley. The valley forms of the tributaries have been discussed. Rajroppa waterfalls, an example of differential erosion fall is an important geomorphic feature in the physiography of the Upper Damodar Valley.

83. Morphological Regions of Orissa.

BICHITRANANDA SINHA, Calcutta.

On morphological basis Orissa can be divided into (1) the coastal plains (2) the middle-mountainous country (3) the subdued plateaus (4) rolling uplands and (5) river valleys.

1. The coastal plains can further be sub-divided from N.-E. to S.-W. as (a) the northern coastal plains, comprising the deltas of Subarnarekha, and Budhabalanga, (b) the middle coastal plains with the combined deltas of the Baitarani, Brahmani and Mahanadi, and (c) the southern coastal plains comprises of the Rushikulya plains. The coastal plains can also be sub-divided into the following regions parallel with the coast: (a) The salt tract with sand dunes, (b) the cultivated tract or the rich rice country with dead leevl flat plains, (c) the sub-montane tract with an undulating topography. The Mahanadi delta, where all the coastal features are prominently exposed. The following sub-regions can also be demarcated from the coast to the inland (1) the recent uplifted belt with sand-dunes (2) the lagoon zone (3) the old deltaic plains and (4) the scattered hillocks. The lagoon zone can further be sub-divided from N.-E. to .S-E. as the active delta of the east, the static delta in the centre and the active delta in the west.

2. The middle mountainous country can be sub-divided into the (a) Simulia and Meghasani mountains (b) the Mankarnacha, Malyagiri and Gandhamardan mountains of Baitarani and Brahmani interfluve (c) watershed between the Brahmani and Mahanadi (d) the common interfluves of Mahanadi, Rushikulya and Vamsadhara and (e) the Pattanga and Chandragiri mountains.

3. The plateaus are sub-divided into:

(a) The Panposh-Keonjjhar-Pal-lahara plateau of the upper Brahmani catchment basin and (b) the Nawrangpur-Jeypore plateau of the upper Sabari basin.

4. The rolling uplands are sub-divided as follows:

(a) the Rajgangpur and Panposh uplands of the Koel and Sankh rivers, (b) the Jharsuguda uplands of the Ib basin (c) the Bargarh uplands of the Jira and Jhaun basins (d) the Bolangir. Titlagarh—Panposh uplands of the northern Tel basin (e) the Bhawanipatna uplands of the southern Tel basin and (f) the Malayagiri uplands of the Sabri basin (5) the river valleys of Orissa include those of (a) Mahanadi (b) the Brahmani and (c) Vamsadhara.

84. Geomorphic Features of Mobile Land in the Floating Gardens of the Dal Lake, Kashmir.

A. N. RAINA, Jammu.

The present paper deals with a detailed geomorphic study of the Dal Lake and its environs. The Lake widens towards the north and narrows in the middle, shrinking with the encroachment of swampy land. Patches of water lie to the west, like the Nagin Lake, with many channels interspersed with swamps. The Lake-depression has a hilly region to its east and south, but its west is plain and the entire drainage of the lake region is in that direction. The winding Jhelum flows to the north-west through Srinagar and its water is controlled by gates across the connecting channel but the lake serves as a flood lung of the Jhelum. Some changes have occurred in the course of the drainage pattern of the Dal Lake and its channels during historic periods, but no considerable effect is seen in the utilization of floating gardens because of mobility of land, a rare phenomena of nature.

The Dal Lake is situated only about a mile to the east of Srinagar where fresh vegetables, seeds and fruits grow in abundance. Nandapur and Hazratbal are the two floating garden villages where people live in boats collecting weed.

A mobile area of about 105 acres is under the floating gardens. There is no soil-bed, no parental rock-substratum, but sheets of a haphazard amalgam of clay and grass. *Pych* is a kind of thick grass which has its roots at the bottom and is the raw material of mats. Its roots are intertwined and to make a hardy floating garden the circular mass of these roots are simply planed off and form the unit of a garden bed. Every year the floating garden is examined with care and if decayed or rotten a fresh bed of this type is got and fixed upon the older one. Cabbage, Turnip, Knol Khol, Radish, Carrot, Water-melon, Musk-melon, Bringel and Green pepper are cultivated in these floating gardens.

85. Drainage Anomalies in Central Ceylon.

K. KULARATNAM, Peradinya, Ceylon.

The Drainage Pattern of Central Ceylon presents remarkable anomalies. Practically the entire area is drained by the head streams of the Mahaveli Ganga. The Mahaveli Ganga is a composite and polygenetic river; rather, it is merely an integrated drainage system. It has grown at the expense of several rivers through piracy. In plan, the Central Highlands region of Ceylon resembles a morsel held firm in the piercing grips of the Mahaveli system.

A morphological study of this region reveals in interesting and intimate interplay of the following determinants of drainage pattern and denudation chronology :—

(*a*) the structural grain of the Archaean synclinorial complex;
(*b*) lithological variations, causing differential erosion;
(*c*) joint control; and,
(*d*) faulting.

Of the above, much of the anomaly is found to be due to local faulting, of which the drainage pattern gives ample evidence; this is further supported by the existence of late-mature erosion surfaces at diverse elevations within the area.

In the light of these, the elbow bend at Katugastota, the reversal of drainage direction in the Dumbara syncline, the underfit transverse gorge between Hanku-

ranketa and Minipe and various other apparently freak features in the pattern are explained and the evolutionary history of the system is built.

86. The Drainage Pattern in the Central Gangetic Plain with Special Reference to Oudh (U.P.).

V. C. MISRA, Sagar.

Part of the Central Gangetic Plain is included within Oudh (area about 24,068 square miles) which is drained by Rivers Sarda, Ghaghra, Gumti, Sai, all tributaries to River Ganga. Any physical map of this area would show the characteristic feature of the drainage viz., all these rivers flow from north-west to south-east and to a great extent parallel to one another. Obviously prevailing slope of the land is the main cause for this form of drainage.

The Oudh plain falls from 550′ to 300′ from north-west to south-east. Thus the average slope of the land is about 14″ per mile. But further studies show that the eastern half of the plain is much gentler, i.e., about 9″ to a mile as compared to the western part where it is 17″ per mile. This means that the rivers in their upper courses run faster than in their lower courses which covers pactically the whole of the region under study.

Further study of the drainage of this area reveals frequent changes in the main channel of these rivers. Due to the slope of the plain and direction of the flow of rivers the right banks in most cases are more susceptible to water attack than the left bank in the region. This behaviour of the rivers is well marked in the rivers Ganga and Ghaghra. Because of the susceptibility of water attack and silt deposition, the river Rapti has changed its course. This has lead to the study of the evolution of the present Rapti system The relief and the present drainage pattern in this part of Oudh support the view that the river Burhi Rapti, at present an affluent of the main Rapti river was the original stream.

Although this plain is a level one but there exist local inequalities. Some drainage patterns like, parallel, interrupted, circular and meandering etc., have been discussed.

87. Pattern of Drainage on either side of Archaean-Cuddapah Boundary.

R. VAIDYANADHAN, Waltair.

The area chosen for the study of the difference in the drainage pattern, lies between longitude 77° 30′ and 78° 30′ E. and latitude 14° and 15° N. in parts of Anantapur and Cuddapah districts of Andhra Pradesh. The Archaean-Cuddapah boundary runs through this area for a distance of about 70 miles. The run of about 23 dykes in the granitic terrain was noted and the attitudes of the quartzites, sandstones, shales and limestones of the Cuddapah system observed in the field. The directions of flow of 60 streams each on either side of the Archaean-Cuddapah boundary were noted. The data has been plotted and compared. It is noted that the streams in the Archaean country flow either northward or eastward following roughly the dykes that run NNW-SSE and E-W respectively. As for the streams over the Cuddapahs, almost all of them are consequents, a few subsequents and only three obsequents. The general direction of the strike of the Cuddapah rocks here being NW-SE and the dip due NE.

88. Evidence of old rivers in Jaisalmer desert.

SIVAPRASAD DAS GUPTA, Calcutta.

This paper gives the record of the work done in 1956 in the desert tracts of Jaisalmer district. In the vast stretches of the rocky desert around Jaisalmer a number of linear depressions, running for miles together, have been noticed. These channels have all the characteristics of old river beds. One such long depression runs for about 25 miles at a stretch with a width of about one mile from bank to bank. It runs from north-east to south-west and passes about 10 miles to the west of Jaisalmer town. The ancient capital of Jaisalmer State, namely Lodhorva, was situated on the bank of this channel. Another channel further to the north-west from Jaisalmer town has also got similar features. Apart from this there is ample evidence of fluvial erosion and riverine deposits all over Jaisalmer. The surface of the desert is rocky and in the depressions fine textured alluvial soil is found which is suitable for cultivation. Sand is almost absent and wherever there is any sand, specially in the outlying regions of Jaisalmer, it is light and very fine textured. It appears that the role of fluvial erosion is more important in shaping the landscape in the Jaisalmer desert.

(ii) Climatology

89. The Climates of India in Relation to the Distribution of Natural Vegetation.

V. P. SUBRAHMANYAM, Waltair.

Starting with the earliest attempts of Köppen at classifying world climates, the paper describes the essentials of the rational scheme of climatic classification developed by Thornthwaite. After a brief mention of the earlier work on the climates of India based primarily on the precipitation-evaporation ratio, it was pointed out how the aridity, humidity and moisture indices of the Thornthwaite scheme are very properly suited for a study of the ecological water balance of the Indian sub-continent.

Owing to the lack of a true natural vegetation map of India, the original Champion map has been used to obtain correspondences between vegetation and Thornthwaite's climatic types. The correlations have been found to be unmistakable and to agree remarkably well with the distribution of vegetation species as reported by various geographers.

The author, however, feels that the work will not be complete or final without an intensive regional climatic study with particular reference to the influence of edaphic factors on the development of natural vegetation associations.

90. Variability of the Annual Rainfall of India and its Vicinity.

P. K. SIRCAR, Delhi.

Although the variability of rainfall can be represented in several ways, *e.g.*, by the standard deviation, co-efficient of variability, interquartile range, and so on, all these involve rather cumbersome calculations, and yet they fail to give indices that are comparable in space (Conrad, 1941 & 1950). One method which is relatively simple, and yet takes into account the entire data, is that used by Gherzi in 1928, but so far not introduced in Indian climatology. The method is very simple. The variability, Q, of the annual rainfall of a place is given by

$$\frac{M-m}{\bar{p}}$$

Where M=maximum, and m= minimum, annual rainfalls observed in the series, for which $\bar{p}$ is the normal annual rainfall.

The present paper has employed this method to 62 stations, for which the data were available in the Climatological Tables of India. The results have been discussed with particular reference to the studies of variability of rainfall by Blanford (1889), Williamson and Clark (1931) and Naqvi (1949).

91. Precipitation Characteristics of the Himalayan Beas Basin.

S. L. KAYASTHA, Varanasi.

The precipitation characteristics of the Himalayan Beas Basin present interesting phenomena. Books on climate and Geography of India often point to the general decrease of rainfall from east to west in the Himalayas, but the anomaly of high rainfall in Kangra Valley especially at Dharmsala (116″ a year) does not find due notice and explanation even though it presents a striking phenomena. This heavy precipitation is mainly owing to the interplay of monsoon currents, the alignment of the ranges and the abrupt rise of Dhauladhar range from 3000′ to over 15000′ elevation. From Kangra Valley (about 80″) the rainfall decreases eastwards to Kulu (less than 50″) and southwards to the lower hills (less than 60″). Precipitation distribution shows a definite physiographic control. Kulu on the leeward side gets only 36·91″ when Jogindernagar less than 20 miles to its west on the windward side receives more than 90″ of rainfall. Two-thirds of the annual rainfall in the area falls during July, August and September except in Kulu which receives only about 50%. The winter precipitation due to westerly depressions varies from 15″ at Dharmsala and Naggar to about 7″ in the lower hills. Snowfalls usually occur in December and January. The total snowfall at 9000′ elevation averages 6′ in depth. Snow does not lie for any length of time below 6000′ elevation and rarely extends below 4000′. The intensity of rainfall varies from 1·2 near Dharmsala to 1·0 in the lower hills and 0·6 in Kulu. There is no rainless month but variations are marked, in total precipitation from year to year, prolonged breaks and late or early rains.

92. A Note on the Climate of the Tarai Region of Uttar Pradesh.

L. R. SINGH KANAUJIA, Allahabad.

The Tarai Region is notorious for its unhealthy climate. Here excessive heat lays its retarding hand upon everything, while a year round prevailing high humidity gives the finishing touch of climatic monotony. The temperatures are relatively high throughout the year, ranging between 60°F (January) and 90°F (May) and the warm season porlongs for about nine months when the mean monthly temperatures remain well above 68°F. Casual and irregular changes of temperature, such as accompany changes of wind and weather, are far less marked in this region. It enjoys a heavy rainfall (50″ to 60″ annually), mostly during the three months (Mid-June to Mid-September) of the rainy season. Not only is rainfall more stable with respect to the variability factor, but marked divergences are also much less common. The rainy season represents the worst climatic conditions. The excessive humidity, often air saturation of 75-90%, combined with high temperatures, becomes intolerable in the extreme and totally benumbs active human nerves. It is always productive of malaria, ague and kindred diseases.

93. Microclimates—A Study in Climatic Variation in the Territories of Jammu and Kashmir.

A. N. RAINA, Jammu.

An attempt has been made in this paper to correlate the distribution of rainfall with temperature on the basis of weather statistics for the last thirty years. A detailed study of the elements of average weather conditions reveal deviation in the climatic rhythm and a marked similarity for some months with the Mediterranean-Continental-Semi-Tibetan type of climate. The division of the territories of Jammu and Kashmir into climatic zones at the same time of the year considering the conditions of temperature, rainfall, direction of winds, wind velocity, humidity, pressure and sunshine show how erroneous is the view accepted generally that the type of climate prevailing in the aforesaid territories is the temperate continental type. The difficulty is felt in dividing the year into seasons for the territories as a whole—a problem in itself complex though interesting .

The prevailing winds are mostly south-westerly in summer influencing the area upto the Pir Panjal on the South and the Uri gorge on the north where the tail of the Monsoons touch. A line drawn from Uri to Poonch and then along the southerly slope of the Pir Panjal roughly 33° North Latitude would form the main wind-divide separating the temperate climatic zone of the Kashmir Valley from the monsoon region—a marked climatic difference. At this period of the year (June to September) beyond Tragbal (13,493′) the Orboreal scenery of the Himalayas fades before the bare grandeur of the Hindu-Kush with its small absolute amount of moisture in the air. Beyond Tragbal the land is arid, bare and forbidding till the Kilik Pass is reached leading to Sheri Maidan (13,600′) where the sun disappears at 2 p.m. and it begins to freeze at 9 p.m. with an average temperature of 15°F. To the east the inhabited valley of Leh (10,500′) has a total rainfall of 3 inches and water boils at 187°F.

The winter cyclones cause snow as the general atmospheric circulation of the Panjab Plain has no direct influence on the weather conditions of the Kashmir Valley. These western disturbances from across the North-west India and Iran cause precipitation in the form of snow creating typical continental conditions (Berlin 31°F) with a marked winter precipitation of about 14″.

In general, the moisture regions mapped in this paper show the detailed regional weather conditions markedly varying according to the altitude and orography.

94. Micro-Climatology of the Bist Jullundur Doab (Punjab) with special reference to Variability of Rainfall.

O. P. BHARADWAJ, Ludhiana.

A detailed analysis of all the climatic elements has been done and the same is followed by a study of annual and seasonal variations of rainfall. The argument has been persued further and the annual, seasonal and monthly variability has been calculated mathematically. The effect of variability of rainfall on agriculture has been emphatically brought out. For calculating the variability of rainfall various methods have been made use of and the superiority of mathematical analysis has been shown.

In the end the synthesis has brought out the main features of the climatic personality of the region.

95. Climate of Akola District, Berar.

N. G. JAIN, Amravati.

The Akola district, lying in between the latitudes of 19° 51′ and 20° 16′ N and the longitudes of 76° 38′ and 77° 44′ E., occupies roughly the middle of Berar and is perhaps the most typical of the Berar district. It is mainly an agricultural district and the study of climatic elements in the district is of vital importance, The district enjoys the reputation of being one of the hottest places in India. Except for the two months of the hot weather (from the middle of April to the middle of June) the climate of Akola district is not uncomfortable. The hilly taluks, Basin and Mangrul, have a slightly heavier rainfall and slightly cooler climate than the other taluks. The cycle of plan growth in the district closely corresponds to seasons in the district. In Akola district the rains are by far the least healthy season, but the district as a whole is by no means unhealthy.

(iii) Human & Cultural Geography

96. The Population Problem of India.

MOHD. YUNUS, Naini Tal.

India is over-populated at present, and the problem needs planning of the population. The crux of the problem is the 'net addition' every year of over 4 million persons. Various remedies, like increasing the acreage under crops and yields, industrialization, etc., have been examined; but they require money and material, technical education, proper planning and above all a long period to implement. By the time a plan completes its five years a swarm of over 20 million awaits to be provided for. Lastly, to provide time for agriculture and industry to develop, the remedy lies in birth control. There are immense difficulties in the way towards the achievement of a planned parenthood, the population of India being mostly illiterate and ignorant. The Government of India now realizes the importance of birth control to ease the 'situation'. The First Plan sponsored family planning services; the Second Five Year Plan allocates Rs. 4 crores to set up 300 urban and 2000 rural family planning clinics. The Plan has some consideration of the principle of planning the population. It is believed that by the time the Plan completes it would have prepared a ground to build up a more prosperous economy for the country.

97. A Geographical Study of Flood Control Problem in South East Asia.

S. N. MEHROTRA and V. S. KATIYAR.

The South East Asian Countries which are mainly the product of their own rivers—the North Indian Rivers, Yellow, Yangtze and Huai of China, Mikiang and Chau Mya of Indo-China, and Agno and Pampanga of Phillipine, are now plauged by them mercilessly year in and year out. They are causing serious disasters. Thus the gigantic hydrologic, Geo-economic and social problem which goes with the floods is colossal and cries for an immediate solution. Being the monsoon lands, the bursting of clouds is the primary cause of floods in South East Asia but their ferocity and frequency are augmented by the man's interference with the nature—deforestation, flood plain occupancy, failure of engineering structures, defective agricultural practices and nuclear tests etc. Though complete flood control is physically impossible but engineering and agricultural measures were adopted to lessen the flood damages in the past. The present Indian Flood Control Plan consisting of engineering, agricultural and vegetational devices is on war footing basis. China, North Vietnam, Phillipine, Indonesia and East Pakistan are also not unaware in this respect.

To meet out this problem international cooperation is essential. For this end India, Nepal, East Pakistan and China are doing well unitedly and the establishment of "FLOOD CONTROL BUREAU" under the direct control of Asia and Far-East Commission is also a well start,

98. The Drainage Disabilities & Flood Problem in Tarai Region of Uttar Pradesh.

L. R. SINGH KANAUJIA, Allahabad.

The Tarai Region of U.P. comprises an elongated marshy belt, extending from the Great Gandak to the Ramganga with an average width of 16 miles, at the foot of the Siwalik hills. It is a land of sluggish streams and water choked morasses. It is entirely crisscrossed by innumerable small streams and 'nalas'. Four river systems, *viz.*, the Gandak, the Ghagra, the Gomti and the Ramganga, account for its drainage. They have hundreds of tributary streams of unstable character; many of them originating in the upper "spring belt", others coming into the Tarai through the Bhabar from the hills. They are marked by meandering courses; duplicated or even triplicated channels and ox-bow lakes; obstructed cross-drainage; and excessive cross-section. All are subject to the discharge vagaries due to unequal rainfall and all are longitudinally 'unstable' owing to changing slopes, hence recurring floods. The Tarai canals because of their unscientific alignment and construction accentuate the problem; tall grasses and forest patches lend a helping hand to wide-spread surface pooling. Nevertheless, the real problem of the tract is sub-soil drainage, hence the measures adopted should necessarily aim at reducing excessive moisture in the soil and preventing water-logging. The need of the hour is that old canals should be replaced by judicious irrigational Schemes and effective flood control measures.

99. Tea Plantation in Assam and its Problems.

SHYAMSUNDAR SHARMA, Varanasi.

Tea, for which Assam is so reputed, was first grown and used in China about 2737 B.C. In 1823 Robert Bruce discovered wild tea in Assam. In 1833 the first garden was planted, in 1836 the first consignment was sent to London. Since then plantations developed gradually and in the last quarter of 19th century tea became an export item.

Tea will grow wherever it is wet and warm. Cheap labour is necessary. Half a million people work in tea plantations, 55% are female and juvenile.

Since 1939 costs have increased threefold, labour costs are about five times. Since 1884 acreage and production both have steadily increased. Its prices depend largely on outside demands. In 125 years Assam has specialised in tea culture. India produces more than 600 million pounds a year and earns 70 crores as foreign exchange from its export.

The industry has however to face certain problems : *Natural calamities* (floods, earthquakes, landslides, soil erosion, hail stones, plant diseases, malarial diseases), *Human problems* (labour, planter's interest and health), *Transport* and *financial.*

To retain its position in the world market it needs more production, but quality and regular propaganda should never be neglected.

100. The Historical Geography of Settlements in Kerala.

V. A. JANAKI, Baroda.

The paper traces the Historical Geography of the settlements of Kerala from the early times to the 18th Century. From a critical study of the available literatures, four main stages can be detected in the historical geography of Kerala.

(1) In the Pre-Dravidian age Kerala was inhabited by forest tribes, more or less nomadic. Some of them had reached a high degree of civilisation. Kerala was then inhabited by Negritoes and Proto-Australoids—Peoples of Neolithic Age.

They had a tribal organisation, with a headman, living in villages knit together by social and religious ties. The centrifugal force in the villages was the common place of worship, the seat of the headman or the village assembly. Some authorities are of opinion that such villages existed only in the Dravidian period.

(2) In the Dravidian era, there existed an elaborate system of villages and towns, partly lost in legend and partly proved by foreign authorities the settlements were trading, administrative and agricultural, but all of them had some emphasis on religion. They also seem to have followed a certain ground plan or pattern. During this period Kerala also witnesses the rule of a line of Perumals brought from the Pandya and Chola Desa. Several settlements came into existence as a result of the activities of these kings and they showed some signs of nucleation.

(3) Towards the eleventh century, foreign powers, especially the Arabs, seem to have settled along the coasts and there was an influx of trading and fishing settlements. These settlements also showed a tendency to nucleation.

(4) The period between the 15th and the 18th centuries was a period of warfare ending in the foreign control of settlements. The Portuguese, the Dutch, the French and the English gained a foothold in Kerala, and the English finally ousted the rest. During this period a communal distribution of settlements is detected based on the idea of caste hierarchy prevalent in the occupational distribution of population in the settlements in ancient days.

101. The Occupations and Industries of the Mauryan Empire.

B. G. TAMASKAR, Amravati.

Though the practice of conducting census of human population was known, it is not possible to ascertain the total population of the Mauryan Empire. However, the occupational and industrial structure of the population can be reconstructed on the basis of the contemporary works.

Farming together with animal-rearing, dairy-farming and poultry-farming, followed by textile industry covering the manufacture of fabrics from cotton, silk, wool, flax, hemp, panicle (*tula*), *Nagvriksha*, Likucha (*Arto-carpus Laucha*), *Vakula* (*Mimusops Elengi*) and *Vata* (*Ficus Indica*) with the associated industries of dyeing, tailoring and washing, and mining with the associated industries of refining ores, manufacture of metallic goods and articles, jewellery, blacksmithy, arms and armament-making and shipbuilding rank among the leading occupations of the Mauryan Empire.

Besides these, food-processing including the manufacture of confectionery, preparation and sale of vegetarian and non-vegetarian foods, liquor-making, and forestry with associated industries may be classed under secondary occupations. Among minor occupations may be grouped toilet-making, perfumery, acting, dancing, music, magic, gymnastics, painting, thought-reading, learned professions, prostitution, carving on stones, wood and ivory, idol-making, architecture, sculpture, hunting, fishing, soldiering, and trade and commerce.

The paper makes a reference also to the geographic distribution of textiles, skins and hides and their varieties. The various kinds of liquors, and forest-products and their utilisation for structural purposes, preparation of medicines, extraction of poisons, separation of fibrous materials and rope-making too are mentioned. It is interesting to note that the conservation of forests and wild life was actively promoted in the Mauryan Empire.

102. Some Aspects of Agricultural Geography of the Mauryan Empire.

B. G. TAMASKAR, Amravati.

The main occupation of the Mauryan times in India had been agriculture. The tillers of the land seem to have been in a state of prosperity and security.

The crops raised included *sali* (a kind of rice), *vrihi* (rice), *kodrava* (*Paspalum Scrobilatum*), *tila* (sesamum), *priyangu* (panic seeds), *daraka* (unidentified), *varaka* (*Phraseolus Trilobus*), *mudga* (*Phraseolus* Mungo), *masha* (*Phraseolus Radiatus*), *saibya* (unindentified), *kusumbha* (safflower), *masura* (*Ervum Hirsutum*), kuluth (*Dolichos Lentflorus*), *yava* (barley), *godhum* (wheat), *kalaya* (leguminous seeds), *atasi* (linseed), *sarshapa* (mustard), sugarcane, cotton, flax, a variety of vegetables, species, medicinal herbs and plants, both indigenous and imported and root crops. Among vegetables are mentioned cucumbers, pumpkins, gourds, sahajan (?), water-melons and musk-melons. The fruits referred to are mangoes, pomegranates, *matulanga* (citrous fruits), *kola* (small jujuba), *badbara* (*Flacoustia Cataphracta*), *sauvira* (big jujuba), *parushaka* (*Grewia Ariatica*), *Jamun* (*Eugenia Jamolana*) and jack-fruits.

The fertilisers used for farming were cowdung, bones and ashes. The modes of sowing, processing of seeds before putting into the soil and ceremonial performances preceding this actual operation are also mentioned. Pastures were not neglected and it appears that a part of India had been still in the semi-nomadic state of life, imposed on the herders of cattle on account of the very nature of their occupation. The natural supply of water from rains for agricultural purposes had to be supplemented by irrigation. The following modes of irrigation obtained in the Mauryan times : (a) Irrigation by manual labour (*Hasta-pravatimam*). (b) Irrigation by water carried on shoulders (*Skand-pravartimam*). (c) Irrigation by means of water-lifts. (*Stroto-pravatimam*). (d) River, lake-reservoirs and well-irrigation (*nadi-saras-talaka-kapodghatam*). The provision of water for agricultural purposes was recognised as an imperative duty by the great Mauryan emperors.

103. Rural Settlements in Madhya Pradesh.

S. M. ALI, Sagar.

The main outline of the network of rural settlements as well as the main types of urban centres in Madhya Pradesh was laid down in feudal times up to the 16th century. During the period when kingdoms or feudalities were coming into being, many rural settlements were replaced by towns or small cities on or near the site of the older settlement especially in valleys of the Nerbudda, Tapti and Wainganga and by the side of lakes on the Malwa Plateau. Such towns were invariably associated with a fort or the mansion of the local chief. Sometimes the old plan of the village which existed prior to the foundation of the town can still be seen in the road network or in the position of the temple.

With settled conditions during the British rule, new settlements came into being on deforested areas. Subsequently, the growth of population and extension of agriculture led to the development of numerous new settlements on the Plateau particularly in the western half of the State. The geographical environment has had an indirect influence on the location and the shape of the settlements, owing to the new economic uses to which local resources were put. Man's attitude to the geographical relief differs according to whether he acts only as an individual, in spontaneously arising settlements, or, as a member of a group, in settlements planned and laid down by the group as a whole. There is a closer connection between man and nature in the first case, since the geographical relief, the nature of the ground and the accessibility of water lead to the location of houses in places where the difficulties set by nature are most easily overcome. Hence in the case of unplanned villages, there is a disorderly grouping of houses on hill slopes and a certain chaos in the development of the villages, although they have straight roads and the shortest connections between one village and another. The paper gives examples of different types of settlements which have grown in relation to certain elements in the relief such as valleys, basins, steep hillsides etc., and brings out the influence of these factors on the pattern of the settlements.

104. House types in Bastar District, Madhya Pradesh.

P. C. AGARWAL, Sagar.

The paper incorporates the result of a study of the house types of the Bastar District of Madhya Pradesh. Excepting for two administrative head-quarters, Jagdalpur (population: 13,793) and Kanker (4,924) the settlements in Bastar are all rural and very small. The rural density of 62 persons per sq. mile is indicative of the sparse population. It is significant that the people of Bastar are overwhelmingly aboriginal. They belong to the tribes called Muria, Abhujhmaria, Bison-Horn Maria, Dorla, Parja and Bhatra etc., mostly grouped as Gond. The lack of roads has kept these tribes quite distinct and, moreover, they prefer to remain segregated from each other for the sake of tribal solidarity.

The House type pattern of Bastar is as interesting and varied as the tribal pattern. In fact the two coincide very closely, particularly as regards the form of the house and the uses to which its various parts are put. The remoteness of the different tribes has naturally prevented the interchange of ideas regarding the form of the house. The variety of house form and occupation plan reveals the difference of outlook of the different tribes. The shape of the houses also varies generally with the tribes. The building materials, however, show much less variety. The luxuriant forests provide the most convenient house-building material. Bamboos have been preferred in comparison to other trees for building the house walls because of its very easy cutting till the specie has been exterminated over large parts of the District. The 'Sal' poles, therefore, replace bamboo for wall making and fencing of the house garden in north-eastern Bastar. The roof skeleton is provided by the bamboo poles practically all over the district and the final covering is a thatch of "chhind", dwarf palm leaves, as this specie grows in wild bushes throughout the District.

105. The Acute Coal Zone of India.

P. DAYAL, Patna.

The paper defines the geographical limits of the acute coal zone of India, i.e., the zone which, on account of distance from the coalfields and the difficulties of transport suffers from a more or less permanent shortage of coal. Coal production in India is more or less concentrated in a small area, the Damodar Valley fields supplying more than four-fifths of the annual output. Hence the transport of coal to the different parts of the country depends essentially upon (a) adequate rail transport availability in the Damodar Valley, with Jharia and Raniganj as the focal points, and (b) the clearance capacity of number of railway stations situated at varying distances from the coalfields. The former, though by no means adequate, is fairly satisfactory, and the main difficulty arises out of the coincidence of the peak period of coal production between January and June with the peak movement of agricultural commodities on the railways. Having been loaded in the field of origin the coal has to pass through a number of bottleneck points before it can reach the places of consumption in the various parts of the country. The paper describes the difficulties encountered at the more important of these points.

A line passing through Mokameh Ghat, Mughalsarai, Chheoki, Katni, Itarsi, Ajni and Waltair, provides what might be called an inner bottleneck-ring within which availability of coal is easy. Another line passing through the bottleneck situated farther afield, Bareilly, Agra East Bank, Ratlam, Khandwa, Jalgaon, Secunderabad and Vijayawada, provides the second bottleneck-ring outside which the coal position is acute. This area, including Madras, Kerala, Mysore, Western parts of Bombay, Rajasthan, Panjab, Himachal Pradesh, Kashmir and a small section of Western U.P., may rightly be called the acute coal zone of India. The power requirements of this zone must primarily be met from other sources. It is gratifying that the greatest development of hydro-electric power has taken place in this zone and there are, in addition, a large number of diesel electric plants.

106. Regional Classification & Soil.

MOHD. YUNUS, Naini Tal.

Classification in geography has been a problem for long. The different factors of geographical environment individually or in combination have been used to delineate regions. Soil, among them, has been the most neglected factor. It is the final product of the correlated and combined influence of all other factors of geographical environment. 'A living organism, which gives life; but itself could not live without life'. The author in this paper has tried to analyse the significance and propriety of soil as a major, basic factor for regional classification.

107. Nature and extent of soil erosion in parts of Kalahandi District, Orissa.

B. C. ACHARYA, Cuttack.

The area around Karlapat and Gunupur situated in the southern and eastern portions of the district of Kalahandi in Orissa, presents a rugged topography with numerous hills rising to heights of more than 3000 feet above sea level. This is locally known as Dangarla. The hills are constituted mainly of Khondalites, granitic gneiss etc. and are covered with light textured and ferrugenous soil. The natural vegetation is mainly Sal, Piasal, and Bamboo.

The area lies in the monsoon belt of the Eastern Ghat Zone and receives an annual rainfall of 70 inches. The local inhabitants are the Khonds, and they practice cultivation known as "Podu" involving deforestation over large areas, on the flanks of the hills.

During the rains, on account of the steep gradient of the ground, loose nature of the soil and local absence of vegetation due to Podu Cultivation, result in heavy erosion of soil. By adopting contouring, terracing, gully plugging and bunding for cultivation in the deforested areas, erosion can be effectively checked.

108. Studies in Agro-Geography of Ranchi District Agronomical Soil Classification.

(Mrs.) B. MUKHERJEE, Varanasi.

Agronomical soil classification includes classification of agricultural lands on the basis of their usefulness in agricultural produce. Ranchi is a hilly district, covered with the old Gondwanaland gneissic rocks. The soils are sedentary in their origin and have some typical characters, broadly classified under red laterite type with wide variations in texture, structure, colour, mineral composition and fertility. Topography governs the agricultural land value which is commonly divided in Don (low lands) and Tanr (up lands). Detailed soil analysis data or soil maps are available hence from an agricultural point of view new classification is being proposed depending on the relative contents of Don (good lands) and Tanr (bad lands).

This gives a wholesome picture of the distribution of good, medium, bad and worse types of lands in the district and sorts out the productive and unproductive thanas. If focussed upon, the reasons for the variations in crop cultivation, irrigational needs, etc. also get clarified. If this is supplemented with soil analysis data (not available) it will be a worthy tool in the hands of agriculturists to judge the fertilizer needs and cultural requirements of their lands.

109. Pedogenesis in West Bengal (Bankura District).

R. LAHIRI and S. VENKATRAMAN, Calcutta.

The moisture content, pore-space, and volume expansion could be measured from one experiment by the use of a perforated metal box, usually called the Keen-Raczkowski box. The details of the experimental procedure has been described in *Soil Analysis*, C. H. Wright.

Five typical profiles of north-west Bankura (West Bengal) have been described in this paper. These represent soils from different parent materials and under different vegetative cover. Soil samples at different depths for all the soils were collected, air-dried, and passed through 2 mm. sieve. The clay fraction in each case was determined by mechanical analysis (Robinson's method). Moisture content of saturated soil, pore space and volume expansion were determined by the Keen box already mentioned.

The results of the measurements may be generalised as follows:

(i) The pore space increases with the increase of clay fraction in the soils. Thus, the porespace at different levels of the soil profile varies according to the variations in the clay content.

(ii) Moisture content of the saturated soil also increases with content of the clay fraction.

(iii) Volume expansion of soils in profiles 4 and 8 bear direct relation to the clay content of the soil. In profiles 3 and 7 the volume expansion decreases in the top-soil with decrease in the percentage of the clay content. At greater depths, however, volume expansion increases in spite of the decrease in the percentage of clay.

The physical properties of the soils investigated here are, however, only 'single value' assessment. In fact, all the values may also be correlated to the nature of the clay mineral, and also to the presence of mineral salts in the soil. Investigations on these lines are in progress.

110. Study of Soil Texture in the District of Howrah.

S. N. MUKHERJEE, Calcutta.

The Soil fabrics consists of Sand, Silt and Clay. Mechanical analysis gives their respective percentages. Ten profiles from the district of Howrah were collected and examined. The surface feature and its variation with depth in each of the profiles were studied. Samples were collected at regular intervals from individual profiles. The textural variations of some of the profiles have been discussed in this paper.

111. Land Utilization in Dudhi—District Mirzapur, U.P.

VIJAYA RAM SINGH, Varanasi.

Bagmandava village presents a representative land use pattern of Dudhi Tahsil in Mirzapur district, U.P. It has an area of about 347 acres with a population of

187 persons. The soil is red and stony. The area is under-developed. Hilly tracts bar the irrigation prospects, but any how rain water is stored in small 'bandhies' which is used for drinking, cattle use and irrigation. Land occupied by plough is 28%, forest 34%, pasture 27% and the rest is waste land whereas the whole Tahsil occupies 77% land under forest, 11% under net cropped area, 6% under pasture and the rest is waste land. Settlements are small and compact clinging to bandhies and double cropped areas. In this tract the problem of subdivision and fragmentation depends upon the crops. Paddy fields are generally slopy and are smal whereas Rabi crops enjoy bigger holdings. Approximately 56% of the plots are below 0·5 acres in size, 14% between 1 to 1·5 acres and only 1·5% about 2 acres. Kharif is predominant and covers nearly 68% of the land whereas 32% land is under Rabi. The Kharif crop is sown at the end of June and in normal years it is grown without irrigation but in the event of rain failure tanks remain unfilled and irrigation is required to protect the crops; the success of Rabi crop depends directly on a sufficient supply of water during cold weather; with the failure of rain fallow lands increase. In Kharif crop maize predominates (25%) because of early ripening nature and long warm summers; it is followed by Sawan (19%), Til (12%) and Rice (8%). In Rabi, Barley (34%), Wheat (31%), and Gram (19%) are the main crops.

112. A Sample Study in Land Utilization near Giridh (Hazaribagh).

N. K. P. SINHA, Varanasi.

The study covers a plot to plot survey of an area of about 706 acres under the jurisdiction of the village 'Kumharlalo' (24° 6′ N. 86° 13′ 20″ E.), which lies at a distance of 9 miles S.W. of Giridih, on the Giridih-Dumri metalled road. The area is situated south of the Barakar and west and north of its tributary stream, the 'Kulmati' and has an elevation varying between 850′ to 900′ above sea level.

The survey reveals that the forests, which formerly were rich and luxurant and covered 55·4% of the area, have degenerated into scrubs and at present cover only 42·5%, the balance turned into barren wastes due to deforestation and consequent soil erosion. With increasing population and jeopardised forest economy, the dependence on agricultural land, which occupies 30·4% of the area, has become almost absolute and has increased the pressure on the land. The pressure on agricultural land here is twice as intense as in the Ganga Plain, for the land available per head of population is 0·33 acre only. The possibility of further extension of cultivation is limited by the small area of culturable waste available (2·31%). The problem of housing is also acute and on an average 3 families live in two houses. 99·6% of the cultivated area yields one crop. There is a marked preponderance of 'Aghani' crops (92% of the net cultivated land). Rice is the most important crop (covering 83% of cultivated area) followed by pulses, oilseeds, kodo, marua and maize. There is lack of irrigation facilities.

The area needs a well-balanced development of its economy with equal emphasis on crop production, forest development, dairy and vegetable production and promotion of handicrafts. The per acre yield of cultivated land has to be increased by all efforts, to support the present population.

113. Land Utilisation of Yamkanmardi, Middle Ghatprabha Basin.

G. S. KULKARNI, Poona.

Yamkanmardi, a village in Hukeri taluka of Belgaum district, is located on the junction of two geological formations—the Kaladgis and the Deccan Traps. It has a population of 5,759 and a total area of about 1,672 acres. The village is situated in the longitudinally—stretching transition belt of the north—Mysore State, and reveals land-use pattern in both the wetter and drier parts lying on the two sides of the transition belt.

The survey reveals the combined control exercised by the morphological features, climate and soils over the land utilisation pattern.

Maximum area under cultivation and raising of a large variety of crops are the main characteristics of the land-use here. Further modifications are possible and are accordingly suggested therein.

114. Environment and Human Responses in the Tribal Region of Bastar (M.P.).

V. C. MISRA, Sagar.

The district of Bastar with an area of about 15,000 square miles lies in the south-eastern corner of Madhya Pradesh. It is the home of a number of primitive tribes and consequently is the dreamland of an anthropologist and geographer alike. Although there are a few main tribes in this area but they are sub-divided into castes. The Murias are in majority and constitute about two-third of the total population. Other chief castes are Marars, Pankas and Gandas. The following study is based on investigation carried on in Kondagaon, and its surrounding area extending over about 150 square miles.

The tribal population of this area is in a state of utter prmitiveness and belong to the hunting and nomadic classes which stick to the dense forest environment in the remote interior of the district. The tribal economy depends a great deal on forests and their products and is greatly supplemented by agriculture and cattle rearing. The houses are built of wood and jungle grass and the dependence on forests and grasslands is so manifest that even the common utensils are made of leaf, gourds and woods. Thus everyday life is a harmonious adaptation of man to natural surroundings. Obviously man is nearer nature in these regions and physical conditions i.e., the relief, drainage, soil types, climatic conditions and natural vegetation are the chief controlling factors which are responsible for determining the characteristic mode of life of the tribals. These environmental factors have also been responsible for the type of their food, clothing, houses, implements and means of transportation. Again, these factors have also shaped their economy in as much as in their occupation i.e., hunting, fishing, forming, lumbering and manufacturing and trade. Lastly, these factors have also influenced the social and cultural set up of the tribals as represented through their manners and customs, rites and rituals, the condition of their healths, their means of recreation and also in the village or clan organisation.

The environment on the whole has made these people maintain a relatively sheltered existence and has induced in them a peculiar sense of self-sufficiency and aloofness which has helped much in their isolation and retention of their identity as a racial unit.

115. Shifts in Areal distribution of Rice Acreages in Bombay State.

C. N. DAFAL, Padegaon.

Developmental planning of a region necessitates the consideration of natural wealth in different parts of that region. The spatial distribution of such wealth helps in locating the points of concentration and differences due to such wealth. This enables decision on such points as rehabilitation, emigration and settling of overpopulation. The analysis of spatial distribution and locational shifts are also useful in planning of aforestation and deforestation; decisions as regards establishing mining colonies; fixing up catch-colonies under fishing, and in hunting for fresh trading-grounds and regions of high and low sales. The process of locational patterns may also be employed with ease.

Geostatistics, a term of American origin, is nowadays used for processing of quantitative data of the spatial distributional type; and although the various parameters under this branch are just the same as in regular statistical science, the methods employed are far different. In this article, some of the principles of this branch as relating to mean and median only are shown for scanning the spatial distribution of rice acreages in Bombay State (as constituted after merger) and to deduce therefrom some relevant, advantageous conclusions, so necessary for the agricultural development with respect to the rice crop of the state.

116. Railways in Madras State.

T. R. LAKHSMANAN and DEBNATH MUKHERJEE, Calcutta.

The Railway system in Madras, in common with the rest of the system in the country combines the typical features of many railway systems in the world. As a network initiated ana built by the British, the physical appearance is essentially British. Its density of track places it in the railnet class of Jefferson and thus affords a comparison with the Spanish network. The break of gauge problem is similar to that of Australia's or that of Poland after the first War. In the relative significance of passenger earnings, the system in Madras resembles that of New England.

The railways in Madras have grown over the last 100 years through the activities ot the guaranteed companies. The earlier main lines from Madras city were constructed on the broad gauge. But railway development came to the greater part of Madras when the less costly metre gauge was advocated for the less important traffic producing areas. The cost of construction was relatively low, but the cost of operations and the rates were high. The railways acquired a dominant position in the carrying trade, weeding out competition from canal or coastal shipping by cutting rates and other dubious arrangements. The railways were finally nationalised in 1944. The growth of railways in the state is traced by a set of six maps that show railways at intervals of 20 years.

The variations in density of railway depicted in Map 7 are traceable in a general way to topography and density of population.

The distribution of gradients in the different sections of the rail network are shown in Map 8. The effect of high grades are noticeable in the Curving routes and Valley alignment. Though relief has a noticeable effect, traffic produced in an area seems to be more important.

The relative importance of the railway stations in the matter of passengers originating and freight handled are depicted in maps 9 and 10. Apart from the concentration on the neighbourhood of Madras, the important sections of passenger movement seem to be the Cauvery, Tambaraparni and Vaigai Valleys. Tanjore district is especially outstanding originating nearly a sixth of all the passengers in Madras State.

The main lines of freight movement are the broad gauge sections leading to and away from Madras. The dominant direction of movement seems to be towards Madras from the north and away from it to the south.

Among the problems confronting the railways in Madras, the familiar break of gauge problem and the traffic bottlenecks are considered. As an example of the latter the Bezwada-Madras section is considered in detail.

117. Selection of appropriate legends for Soil and Land use Maps.

A. K. SEN and (Miss) S. CHAKRABORTY, Calcutta.

Standard legends increase the efficiency of mapping units and simplify the work of a cartographer. Preparation of a soil and land use map needs standard legends. Columnar diagrams, symbolical representation of dots, superimposed columnar diagrams, star and arrow diagrams, 'pie' and Bar graphs etc., have been shown to be most appropriate legends of soil map to show its characteristics. Soil groups and Types have been suggested to be depicted by hatching and colouring respectively.

For a land use map, colouring to distinguish different land capabilities has been suggested. In the case of a combined land use and soil maps descriptive cum diagramatic legends have been suggested.

In this paper the authors have suggested some standard symbols and their use in maps.

(iv) Urban Geography

118. Techniques of classifying the Functional Zones of a city.

AMAL KUMAR SEN, Calcutta.

Entire activities of a city region, along with its functional diversities is focussed on the city proper. The demarcation of the functional zones of a city is then, not merely a Primary abstraction but has some concrete expressions. The study reflects beneficial factors for balanced regional planning. In the paper the author pleads for a standard technique for classification of the functional zones of the Urban areas and in turn suggests some possibilities of such from his own field experiences.

Street pattern, good for rapid survey and 'house types' for preparing choroschematic maps can not measure the social and economic structure and as such help little in regional planning. Due to the 'mobile' and 'moving' characteristics of urban population, merely the actual numbers, residing in the city can not bring the satisfactory volume of urban population. Accordingly, three separates of urban population, 'residential cum non-dependent', 'residential cum dependent' and 'non-residential cum dependent' of each zones to be considered have been traced. The sum total of the separates has been termed as 'Urban population complex'. Definition of functional classes according to size distribution of these separates has been defined and set forth in a graphic form.

119. Urban Trends in the Lower Son Valley.

NARVEDESHWAR PRASAD, Varanasi.

The Lower Son Valley extends from the eastern exit of the narrow gorge near Argarh (500′ above s. l.) down to the Son-Ganga confluence near Bingawan (about 165′ above s. l.). The region on the whole has shown a growing tendency towards urbanization during the present century. In course of 50 years (1901 to 1951) although the total population of the region increased by 53·8 per cent, the increase in urban population was over 90 per cent. It clearly indicates the positive trend in urbanization because both absolute and relative increases in urban population were considerable. In the first two decades (1901 to 1921) population decreased owing to natural calamities. In this period the urban population declined by about 10 per cent; but in the succeeding three decades it showed a tremendous rise and the 1951 census recorded an increase of 112·3 per cent in urban population over that of 1921. The number of urban centres too, increased from 7 in 1901 to 10 in 1951. These centres are well distributed—4 in the Son-West Plain, 5 in the Son-East Plain and 1 in the southern hilly Tract. The population of Patna has more than doubled during the last three decades. In 1921 the total urban population of the whole region was much less than the present population of Patna alone. In addition to the numerous factors promoting urbanization in the region, Patna still enjoys the advantage of the geographical inertia. The phenomenal rise in the population of Dehri and Khagaul is owing to industrial developments and the growing importance of the divisional head quarters (at Dinapore) of the Eastern Railway. The other towns, except Aurangabad are just keeping pace with the natural increase of population in the region.

120. Trend of Urbanisation in the Lower Ganga-Yamuna Doab.

N. K. SINGH, Varanasi.

The Lower Ganga-Yamuna Doab, extends from the interdistrictc boundary between Farrukhabad and Kanpur down to the confluence of the two rivers comprising an area of 4,830 sq. miles. It is essentially an agricultural region. It has about 30% of urban population and is apparently more urbanized than the state as a whole (13·6%). It has thirteen urban centres (1951 census) of which two are cities, one large town and the rest ten small towns whereas in 1901, there were only five small towns in addition to the two cities.

During fifty years (1901-'51) the urban population recorded a phenomenol increase of 165·8% while the total population increased by only 42·2%. It clearly indicates the positive trend of rapid urbanisation. It is, however, interesting to note that the progress of urbanization was not uniform in all the centres. Kanpur, the top ranking city, owing to its industries and the impetus given by the second World War recorded an overall increase of 250% though during the first decade it decreased by 12%; in 1931-'41 alone its population increased by about 100%. Allahabad, the other city has shown a fluctuating trend. Its population was almost stationary during the first decade, decreased by about 8% in the second and increased by about 17, 41 and 27% during the third, fourth and fifth decades respectively. Of the small towns Bilhaur and Bithur have shown a decline by shifting from Class V to Class VI. Bithur suffered due to the shift of administrative headquarters to Kanpur and Bilhaur probably due to the decline of river borne trade. Other centres have registered an overall positive trend.

In the region as a whole the total population decreased during the first two decades. The urban population also declined during the first decade, but the positive trend in urbanization saved it during the second decade and thenceforth shows an overall positive trend.

121. The Suburban Zone of Jabalpur.

N. PANCHAPAGESAN AYYAR, Sagar.

The development of suburban zones in large cities and particularly in rapidly growing centres is a common featrue. Such suburban zones develop in response to industrial expansion, growth of population, extension of communication facilities and the need for more open space. The relationship between the Suburban Zone and the Core or the main Urban Centre becomes an interesting study in Urban Geography and the study of such relationship often helps one to plan scientifically.

This paper deals with a study of Jabalpur and its suburbs. An attempt has been made to delimit the suburban zone on the basis of certain criteria like, geographical contiguity, daily movements of population, economic interdependence etc. Then brief details regarding the physical background are given, viz., local relief and geological features, climatic characteristics and local vegetation of soils.

Main emphasis is, of course, laid on those characters that make the zone suburban. The suburbanity of the zone is indicated by such factors as the movements of working population, the gradual migration of residential population from the core to the outlying parts etc.

The question of land-utilization within the suburban zone has also been analysed. Apart from agricultural occupation for vegetables and fruits, there are important cottage and other industries of which iron smelting, making of cotton and woollen blankets, potteries, dyeing etc. are important. There is, of course, the very important Gun Carriage Factory at Khamaria. With reference to land utilization, the marking of functional zones on the basis of distribution of functions (like residences, offices, shops and others) has also received attention.

The demographic features in the suburban zone prove interesting study, especially with reference to similar features in the Core. Reference is also made to the problem of growing population, sex-ratio, occupational distribution of population and allied topics.

Finally, some of the current problems of the suburban zone of Jabalpur have been dealt with and suitable suggestions offered. Light is also thrown on the planning of the suburban zone in consonance with the natural demands of this growing city.

122. Land Utilisation Survey of Ajudhya Chak Village Dist. Gorakhpur.

(Miss) SURRINDER PANNU, Varanasi.

The present study constitutes the land utilization Survey of Village Ajudhya Chak in Sadar Tehsil, District Gorakhpur, U.P. It lies near Sardarnagar railway station, and is traversed by a Kutcha road, which links it to Gorakhpur, Kasia and Deoria. This village is situated at a height of 255′ above sea level and is a typical village of the Uparhar tract of the Saryupar plain. It often experiences floods or droughts owing to the irregularity of rainfall. The floods caused by poor drainage frequently affect the western portion of the village. Soils of the village have been described as "the leached Calcium soils" and fall under the category of ordinary loam. Average water table is about 5′-6′ below ground level during monsoons and 15′-20′ during summers. There are three tube-wells and a number of ordinary wells for irrigation.

The 1st survey was carried out in 1914-15. When more than ¾ of the area was under forests and grass. It was cleared off by 1928-29 and was brought under mechanized cultivation by Majithias, the biggest land lords there. The main food crops of the area include rice, wheat, peas, arhar, kodon, barley and maize etc. while non cereals crops constitute, sugar-cane, til and chari (fodder). Suger-cane covers about ⅔ of the total land under cultivation. Owing to the nearness to the Saraya Sugar Factory and distillery there is good provision of employment to the villagers.

123. Faizabad-cum-Ayodhya: A Study in Urban Settlement.

R. L. SINGH, Varanasi.

Faizabad with a population of 82,498 (1951) is the youngest city of the umland of Banaras. It is situated on the north bank of the Ghaghara at a distance of 78 miles from Lucknow, 92 miles north of Allahabad and 125 miles north-west of

Banaras. It is quite close to the ancient town of Ayodhya, being only 4 miles to the west of it. The city developed independently of its much older neighbour and reached its zenith in the 3rd quarter of the 18th century. It began to decline after 1775 and has not since been able to regain its former glory. Since 1869 the two neighbouring towns have been united by the constitution of a municipality which includes within its limits portions of small villages such as Janaura, Deokali, Ranapali, etc. In this paper an attempt has been made to analyze briefly the circumstances in which Faizabad developed so recently in the immediate neighbourhood of an ancient but living city, the causes of its decline and its present morphology.

124. Umland of the Twin-Township of Dehri-Dalmianagar.

K. N. SINGH, Varanasi.

Perhaps very few towns furnish a better example as a true representative and 'mirror of the age and epitome of their region' than the twin-township of Dehri-Dalmianagar. The small bazar of Dehri, functioning as a 'landstadt' in the true German Spirit of the term, in a predominantly agricultural area, rose in the early thirties of the present century as a great commercial and industrial township, depending on the varied resources of its region—the Kaimur hills and the neighbouring Ganga Plain, and the accompanying onset of means of transport and communication through canal, roads and railroads. It developed, in its wake, various economic and social institutions like cinema, clubs, libraries, parks, playgrounds, schools, insurance offices, banks etc., which only confined all the more the interdependence of the twin-township and the surrounding region.

We may delimit the 'sphere of influence' of the twin-township of Dehri-Dalmianagar by adopting five main services as criteria :—(i) educational influences, (ii) medical service, (iii) sugarcane supply, (iv) marketing influences and (v) roadways transport service. The educational and health services signify the cultural aspect, sugarcane supply displays the industrial role, marketing and shopping influences denote the commercial functions, while the roadways transport service appreciates the natural nodality of the township and its behaviour as a route centre.

It is interesting to note, however, that both physical and cultural factors function as negative forces in the sphere of influence of the township. River Son is a great physical barrier in spite of the railway connection and causeway over it; while Kaimur Hills in the south form another. Again, inter-urban competition between Dehri and Sasaram is very great : Sasaram interposes effectively on educational and marketing influences. The industrial influence of Dalmianagar is so wide that it exercises a centrifugal force. In view of all these, the boundary delimiting the 'sphere of influence' of Dehri-Dalmianagar corresponds with the Mohania-Bhabua-Ramgarh line in the west, Rohtas in the south, Bikramganj and Nasriganj in the north and Daudnagar-Palmerganj-Aurangabad line in the east. Thus the 'sphere of influence' of the twin-township of Dehri-Dalmianagar covers approximately an area of 2080 square miles with an approximate population of twelve lakhs.

125. Evolution of the Townscape of Murshidabad (West Bengal).

N. D. BHATTACHARYA, Varanasi.

Murshidabad (24°12′ : 88°17′), Capital of Bengal during Mughal regime, enjoys a commanding position in the Lower Ganga valley. The town is situated on the 'Bagri'—the eastern bank of the river Bhagirathi and lies at a distance of 122 miles north of Calcutta and 6 miles from Berhampore, the district headquarters.

The earliest name of the city was Masumabazar. During the seventeenth century, it rose to the zenith of commercial activities and acquired a reputation in silk fabrics.

The morphology of the city is the outcome of various stages of its development since ancient times. The main phases of evolution dealt with are: (i) Ancient sites—Kiriteswari, Kusumkhola and Akbarpur; (ii) the early 18th century (1704-1740 A.D.) when Murshid Quli Khan transferred the seat of Government from Dacca to Makhsudabad and named the place after himself: this period witnessed an over-all change; (iii) the mid-18th century (1740 to 1765)—the reign of Alivardi, Siraj and Mirzaffar—when the city experienced the highest cultural development; and (iv) between 1765 to 1772—when a conspicuous devastation in the townscape set-in.

Later on, both physical and political factors were responsible for this rapid decay. A well-marked change can only be visualized after the partition (1947).

The 1951 census returned 10,756 persons and thus it is a class IV Municipal town. It is a Sub-divisional headquarters and covers 5·00 sq. miles. Evolution of the townscape is analysed in detail in the paper.

126. Cuttack—A study in Urban Geography.

RABINDRANATH RAY, Cuttack.

Cuttack, lying at an important geographical position, began as a castle-town but later grew into a prosperous commercial city. It had four phases of development: (i) the period of ancient Hindu kings when the city was strengthened by forts, moats and dykes. Centres of population developed at this time in Biranasi and Tulsipur areas; (ii) during Muslim occupation, when well-populated areas developed on the north bank of Kathjori; (iii) Marhatta regime, when population became peripheral; and (iv) the British occupation, when settlement grew up on the south bank of the Mahanadi river.

Cuttack's functional zones are ill-defined. Wholesale trade areas are Balubazar-Marwaripatti, Malgodown and Chattrabazar. Residential areas lie north of Kathjori river and in Cantonment road—Tulsipur, Raveushaw College—railway station and Chauliaganj—Nayabazar areas. Administrative areas are near Kathjojri river, Cantonment area, Police lines and Chauliaganj. Centres of culture are scattered.

The chief industries of the city are filigree and horn work. The problems of the city are mainly congestion, sewerage and inadequacy of milk and vegetable supplies. The shift of Capital is justified.

A Master plan has been undertaken for betterment of Cuttack. Its programme includes removal of congestion, land reclamation, opening of industrial belt and cultural centres.

(v) Economic Geography

127. Ludhiana—A study in Industrial Development.

A. S. JAUHARI, Varanasi.

Ludhiana has gradually assumed industrial character and a very large number of small scale industrial units have grown up during the last few decades. Tall chimneys puffing out smoke and darkening the skies so characteristic a feature of modern industrial landscape and of capitalist economy are conspicuous by their absence, although the town may be regarded as a beehive of variety of important industries.

On the five main industries—hosiery, textiles, cycles and cycle parts, sewing machines and component parts and engineering the hosiery industry is the oldest and surpasses all others in the number of units, capital invested, and quality of products. Thus Ludhiana has aptly been called 'the Leicester of India'. It was owing to certain historical factors that the hosiery industry was established here. But once the industry gained momentum it continued to make rapid progress in spite of serious loss of much of its skilled labour at the time of partition. The wartime shortages of essential parts resulted in the establishment of hosiery machines industry in the twenties of the present century. The manufacture of component parts and accessories of bicycles started in the thirties, but it was during and after the Second World War and more especially after partition that cycles and cycle-parts industry and the sewing-machines industry got firmly established in Ludhiana. Healthy climate, industrious people and the nodality of the town have favoured the concentration of industries in Ludhiana. The problems of the industries, however, are many The quality of metal, and the foundry equipments of the engineering industries need considerable improvements. Moreover, there should be co-ordination and cooperation among the small scale units so that they may derive full benefit from the technical skill of the workers of different units and also avoid harmful competition among themselves. Most important, however, is the fact that as the *small unit* is the essential character of the industrialisation of Ludhiana, the tendency to grow into big factories should not be encouraged.

SECTION OF BOTANY

President :—PROF. T. S. SADASIVAN, Ph.D., D.Sc., F.A.Sc., F.N.I.

Abstracts

VIRUS

1. A Mosaic Disease of Garden Petunias.

K. S. BHARGAVA and N. S. BISHT, Naini Tal.

A virus disease of garden Petunias has been recorded from gardens in Naini Tal. The affected plants are stunted and dwarfed with mottled, deformed leaves. No seeds are set in these plants. The causal organism has been identified as a strain of Cucumber mosaic virus.

BACTERIA AND ACTINOMYCETES

2. Effect of Nutrition on the Production of an Antifungal Substance produced by a strain of Streptomyces Griseus from Agra Soil : II.—Nitrogen Sources.

K. C. BASU CHAUDHARY, Agra.

An antifungal substance produced by a strain of *Streptomyces griseus,* was reported (Basu Chaudhary, 1956) to be antagonistic to *Alternaria solani* and *Helminthosporium oryzae*. Presently the effect of twelve nitrogen sources (Alanine, Glycine, Glutamic Acid, Peptone, Asparagine, Ammonium Nitrate, Ammonium Sulphate, Ammonium Chloride, Sodium Nitrate and Sodium Nitrite) on the growth of the organism and the production of the antifungal substance were investigated. Equal amounts of nitrogen from different sources were added to 30 ml. of Basal Medium. The potency was measured after 7, 10, 13 and 16 days after which the mycelial dry weight was taken.

The nitrogen sources taken into consideration in the experiment can be classified into six groups according to their titre and the rate of growth of the organism. The groups are : (1) Alanine, Glycine and Glutamic Acid, (2) Peptone and Asparagine, (3) Urea and Acetamide ,(4) Ammonium Nitrate, (5) Ammonium Sulphate, Ammonium Chloride and Sodium Nitrate and (6) Sodium Nitrite. There is a distinct correlation among the rate of growth, the source of nitrogen supply and the production of the antifungal substance which is maximum in group (1st) followed by (2nd), (3rd), (4th), (5th) and (6th).

3. Effect of Nutrition on the Production of an Antifungal Substance produced by a strain of Streptomyces Griseus from Agra Soil : II.—Organic Acids.

K. C. BASU CHAUDHARY, Agra.

This paper deals with the effect of Organic acid and supplements on the production of an antifungal substance produced by a strain of *Streptomyces griseus* isolated from Agra soil and on its rate of growth. The organic acids (Fumaric, Malonic, Oxalic, Succinic, Malic, Tartaric and Citric) were added to the Glucose Broth at the rate of 1% w/v and the pH was adjusted at 7·5. The potency was measured at a regular interval of 7, 10, 13, and 16 days after which the rate of growth was measured by taking the dry mycelial weight.

A direct relationship between the rate of growth of the organism and the production of the antifungal substance was observed in all the organic acids. The Malic and Citric acids were the best supplements in which there was maximum production and also the most healthy growth of the organism. These are followed by Tartaric, Succinic, Fumaric, Malonic and Oxalic acids.

4. Survey of the Actinomycetes occuring in Kashmir Soil.

P. P. MUKHERJEE, A. K. MISHRA and P. NANDI,
Bose Institute, Calcutta.

A careful survey of the Actinomycetes occurring in Kashmir soil was carried out. Soil samples collected from different parts of Kashmir were plated on Thornton' and Norris' media and incubated at 24-25°C for a period of six days. Colonies were then picked up and studied. Out of the eighteen soil samples, 248 colonies were isolated. These were tested against bacteria (*Staphylococcus aureus, Vibrio cholerae, Eberthella typhosa, Escheriehia coli*) and fungi (*Alternaria solani, Aspergillus niger, Curvularia spicifera,* and *Fusarium vasinfectum*) by the usual agar cup and agar-streak methods. Of all the strains isolated, only eight showed promising character; some of them were highly antibacterial and others antifungal. Some of the strains produced pigments which were violetish and brownish in colour on CDA, NA, Ac-straw media.

Two strains produced pigments having acid base indicating properties. The isloation of the active principles from the potent strains is now being carried out and the work is in progress.

5. Isolation of Antibiotic substances from a strain of 'Bacillus subtilis'.

M. PURAKAYASTHA and P. NANDI, Calcutta.

From the large number of antibiotic-producing bacteria isolated during the course of a survey of antibiotic-producing bacteria of Indian soils, culture number B7, identified as a strain of *Bacillus subtilis* was chosen for the isolation of the active principles elaborated by it. It has been found to produce at least four antibiotic substances. The active principles were resolved by (i) solvent extraction, (ii) counter-current distribution, (iii) adsorption chromatography, and (iv) ion-exchange chromatography. The presence of the two major fractions were revealed by solvent extraction method and also by counter-current distribution. By adsorption chromatography on alumina the presence of a third fraction was detected, ion-exchange chromatography with Amberlite IRA 120 revealed the presence of the fourth fraction. That these fractions were four different substances were confirmed by their different Rf values in different solvent systems and also by their antimicrobial spectra. Fraction (I) is present in the largest amount (II), (III) and (IV) are present in extremely small amounts. (I) is a yellowish brown powder, soluble in alcohols, insoluble in ether, water and acids but soluble in alkali. (II) is a white amorphous powder soluble in alcohols, ether etc., but insoluble in water. (III) is a yellow powder soluble in water acetone etc. (IV) is a pale white powder soluble in alcohols but insoluble in water. (I), (II) and (IV) are polypeptides of different amino acid composition. (I) is active against *Helminthosporum sativum, Curvularia sp. Alternaria solani* etc., and (II), (III) and (IV) are active only towards *H. sativum.* None of the fractions was found to be active against *Aspergillus niger.*

ALGAE

6. Nucleic acid control of polysaccharide synthesis in '*Nostoc muscorum*'.

B. B. BISWAS, Bose Institute, Calcutta.

In view of the fact that a polysaccharide was associated with a nucleic acid fraction, DNAII, of *Nostoc muscorum* it was considered worthwhile to investigate the dependence of polysaccharide synthesis on the presence of nucleic acids. The polysaccharide is composed of glucose, galactose, ribose, arabinose, xylose and two unidentified components. It has been observed that when DNAase-treated cells were allowed to metabolise $NaHC^{14}O_3$ in presence of light, the C^{14} fixed in polysaccharide fraction was much less than that of the control; that was also the case with DNAI and DNAII fractions, indicating a probable relationship between the syntheses of polysaccharide and DNA. With RNAase the effect was less marked. With the addition of glucose the activities in polysaccharide, DNA and RNA were more than with arabinose alone. Glucose and arabinose together were as effective as the mixture of five sugars namely glucose, galactose, ribose, arabinose and xylose. With ATP the C^{14} activity in polysaccharide, DNA and RNA fractions increased showing thereby that the syntheses of polysaccharide and nucleic acids are coupled with energy transference system.

7. Cytotaxonomic studies on '*Physolinum monile*' (De Wildem.) Printz.

Y. B. K. CHOWDARY, Banaras Hindu University.

Some aspects of the cytology and Life-History of *Physolinum monile* (De Wildem.) Printz have been studied in the material collected from nature as well as in the material maintained in cultures on agar plates. The alga reproduces by biciliate swarmers produced in cells which hardly differ from vegetative ones. The chromosome number is 22. The systematic position of the alga has been discussed.

8. A new species of '*Botrydium* (*B. lateralis*' sp. nov.).

Y. B. K. CHOWDARY, Banaras Hindu University.

The characteristic feature of this new species is its lateral branching, in which respect it differs from all the previously recorded species of *Botrydium*. The method of branching has been followed in the living material from nature as well as in the material grown in cultures on agar plates in modified Chu No. 10+10 cc. of soil extract kept near 60W. bulb in constant temperature room maintained at 25 C. The cytology of the alga has been studied and the chromosome number has been found to be 18 ± 2. A spectrophotometric analysis of the pigments has been made and some observations on the developmental stages of the alga has been recorded.

9. TTC-reaction in Blue-green Algae.

K. SUBBARAMAIAH, Banaras Hindu University.

In some of the Blue-green Algae, the reducing activity has been investigated by using 0·05 per cent 2, 3, 5-triphenyl-tetrazolium chloride. The red coloured formazan appears round a number of granules which are irregularly distributed in the cells. The granules are found to occur in large numbers in the apical cells of the hormogones of *Porphyrosiphon Notarisii* (Menegh) Kütz., suggesting apical dominance of the reducing activity. The same granules have been found to be osmophilic, thus indicating their lipoid nature and are also unaffected by acid hydrolysis. The latter property precludes them to be the cyanophycean granules. By using Sodium succinate as the substrate they have been shown to be the sites of Succinic dehydrogenase activity.

FUNGI AND PLANT DISEASES

10. The assimilation of sugars by three pathogenic species of 'Phyllosticta.

K. S. BILGRAMI and R. N. TANDON, Allahabad.

Three parasitic species of *Phyllosticta* viz., *P. caricapapayae, P. mortoni,* and *P. morifolia* were isolated from infected leaves of *Carica papaya, Mangifera indica* and *Morus alba* respectively. The pathway of assimilation of six oligosaccharides by these organisms was studied chromatographically. Maltose and sucrose were assimilated through a hydrolytic pathway. Maltose was a better source than its hydrolytic product (glucose), while sucrose and a mixture of glucose and fructose were almost identical sources. Melibiose was hydrolysed by two species only viz., *P. carica-papayae* and *P. mortoni.* Raffinose, lactose and cellobiose were unsuitable sources and they were used up through non-hydrolytic pathway. Hydrolytic products of these oligosaccharides supported very good growth of all the three fungi. The organisms synthesized an oligosaccharide (maltotriose) from maltose. *P. carica-papayae* and *P. mortoni* were capable of synthesizing an oligosaccharide of unknown composition with melibiose also. Glucose and galactose were the best sources amongst the hexoses and the difference in their structural configuration did not play any important part.

11. Study of Physiologic Specialization in 'Puccinia Penniseti' Zimm. on 'Pennisetum Typhoides' Stapf & Hubb.

G. G. DALELA and S. SINHA, Agra.

Rust reactions of *Puccinia penniseti* zimm. on seedlings of *bajra* (*Pennisetum typhoides* Stapf & Hubb.) were studied and classified following the types designated by Stakman and Levine (1922) for wheat rust. Twenty-nine *bajra* varieties were tested, each with ten samples of the rust. All the host varieties were found susceptible to each of the rust samples. The rust reactions were of types 3 and 3-4, thus indicating little difference in the reactions, although Basu Chaudhary and Sinha (1955), Ramakrishnan and Sundaram (1956) and Delela and Sinha (1957 a & b) suspected physiologic specialization in the rust. The present investigation indicates that much more extensive analysis work will have to be done to establish definitely physiologic specialization in *Puccinia penniseti* Zimm.

12. Yeast from Kanji.—(I).

G. R. GHOSE, Cuttack.

Kanji—is a popular liquid diet of Orissa, prepared from fermented starchy decant of cooked rice, called 'Torani'. From six different sources of torani 21 isolates of yeasts were obtained. Eleven have been identified and the following is the report on them.

The cultures 1, 6, 10 and 14 have been identified as *Hansenula anomala* (Hansen) H. et. P. Sydow var. *Ciferri* Lodder et V. Rij. The variety differs from the species in being slow in the formation of the pellicle on the malt extract medium; after one week none of the cultures had formed a pellicle, just an island had developed on the liquids surface. In other respects the cultures answered to the description of *Hansenula anomala;* hat-shaped ascospores, 1-3 per ascus, were produced by all 4 cultures on V_8 (vegetable agar), Gorodkowa, Fowell's acetate medium and on gypsum blocks.

The cultures 9, 12 and 15 are identical with *Candida tropicalis* (Cast) Berkhout. These cultures answer well to the description.

13. Yeasts from 'Kanji'.—(II).

G. R. GHOSE, Cuttack.

Culture 3 is identical with *Candida guilliermondii* (Cast.) Langeron et Guerra var. *membranaefaciens* Lodder et v. Rij. Its identity with this variety could be demonstrated by mating the culture with one of the mating types of this species received from Dr. L. J. Wickerham. With one of these types hat-shaped spores were formed after conjugation.

Cultures 2, 4 and 7 are however not yeasts and are identified as *Geotrichum candidum* (=*Oospora lactis*). They produce an early thick pellicle on the liquid medium, which has a mouldy texture. The hyphe branch dichotomously and fall apart into arthrospores. Sugars are not fermented (no gas evolved) and only glucose and galactose are assimilated.

A peculiar feature of these cultures is, however, that certain endospores (perhaps ascospores) are being formed. Some develop in special cells arising from the hyphae on a curved stalk; others are produced in the hyphae of an arthrospore. Sometimes 2 such spores are formed, both may be found in the hyphal cell or one spore has developed in the hyphal cell and the other spore in the cell arising there from on a stalk. The sexual act, accompanying the formation of the spores could not be traced. A special cytological study is necessary to reveal such a phenomenon.

14. Influence of H-ion concentration on stem rot disease of Coriander caused by 'Sclerotinia Sclerotiorum' (Lib.) de Bary.

J. S. GUPTA, Agra.

Influence of six H-ion concentrations (4·6, 5·6, 6·6, 7·4, 8 4 and 9·2) on disease development of stem-rot of coriander caused by *Sclerotinia sclerotiorum* (Lib.) de Bary was studied. Sand cultures, irrigated by modified Shive nutrient solution, were maintained to grow coriander plants. The six pH levels were adjusted by use of N/10 HCl and N/10 NaOH as buffers. Sand around each plant was infested with the fungal mycelium when plants were 9″-12″ tall. Observations were recorded on mortality rate as well as on total mortality.

Results indicate that pH has almost negligible influence on the expression of the disease. In all the pH levels plants started collapsing after about three weeks and the total mortality reached within six weeks. But the gross mortality rate was influenced by soil reaction, the mortality rate being higher in pH 7·4 than the acid series (4·6, 5·6 and 6·6) or alkaline series (8·4 and 9·2).

15. 'Septoria lycopersici' Speg.—a Serious Leaf Spot Disease of Tomato in Naini Tal Area.

S. C. GUPTA, Naini Tal.

A severe leaf spot disease of tomato caused by *Septoria lycopersici* appears in the early part of the rainy season every year in this area.

The infection starts with the appearance of small, irregular and brownish spots on the older leaves which become chlorotic and soon droop down. The infection then spreads to younger leaves, rachis, petiole and stem. The attacked leaves later fall off and only 2-3 leaves remain at the top of the infected plant. Formation of fruits is checked.

This is the first record of *Septoria lycopcrsici* Speg. on *Lycopersicum esculentum* Mill. from Northern India.

16. Studies in Ustilaginales. 2. Morphology and spore germination of 'Pericladium grewisae'.

N. C. JOSHI, Ajmer.

A serious Smut disease of *Grewia* sp. caused by *Pericladium grcwiae* has been reported from Ajmer. The symptoms of the disease are mainly found on the petiole, twigs and branches of the plants. The disease can be easily detected by the blister like pustules which are covered by the coriaceous hard woody indusium made of the host tissue. The diseased plants get deformed and stunted. At maturity the pustules expose the powdery mass of black spores. The spores are ellipsoidal, greyish brown, 5·5-9 μ in diameter (i.e. 8·5 μ in average). The epispore is thick and smooth.

The spores easily germinate in water and give rise to a septate promycelium with a single terminal sporidium which easily gets detached.

Observations on the effect of different salts, sugars and pH on the germination of the spores have been made.

17. Studies in Ustilaginales. 3. Morphology, Cytology and spore germination of 'Entyloma dahliae' on 'Dahlia variabili' Desf.

N. C. JOSHI, Ajmer.

Entyloma dahliae causes the greyish or brown spots on the leaves and petioles and sometimes causes an epiphytotic on *Dahlia variabilis* Desf. in the hills (i.e. Almora and Mussoorie) of Uttar Pradesh.

The mature chlamydospores measure 11 to 15·2 μ in diameter and have diploid nucleii. Fresh chlamydospores germinate within 72 hours in water. The maximum percentage of germination was in 5% malt extract. On germination a long aseptate promycelium with 4 to 6 sporidia at its tip is given out. The sporidia are elongated and measure 20 to 35 μ x 3 to 5 μ in dimension. At the time of germination of the spores the diploid nucleus migrates into the promycelium and there the division takes place. The conjugation tubes develop between two sporidia. The nucleus of one goes to the other and consequently the binucleate sporidia are formed. The binucleate sporidia may directly give rise to a mycelium which later on formed the chlamydospores.

18. Studies in Ustilaginales. 4. Morphology and Cytology of 'Tilletia eleusines' on 'Eleusine verticillata'.

N. C. JOSHI, Ajmer.

A species of *Tilletia, Tilletia eleusines* Syd. has been collected in the ovaries of *Eleusine verticillata* from Ajjmer. The spore mass is brownish black and the spores are yellowish brown with prominent reticulations on the wall. The spores measure 17 to 15 μ in diameter (with a mean 19 μ). The spores are hyaline and smooth and measure 9 to 11 μ in diameter.

The mature chlamydospores are diploid. About 50 to 60% of the spores germinated when they were first treated with bleaching power and kept at a temperature of 5 to 8°C for a week and then kept at room temperature for 15 to 20 days.

The spores on germination give rise to long aseptate promycelia, each bearing 8 sporidia at the tip. The first division of the nucleus takes place in the promycelium and is followed by the second and third division resulting in 8 nuclei.

A single nucleus goes into each sporidium. The fusion between primary sporidia is accompanied by short conjugating bridge. The nucleus of one goes into other. The primary binucleate sporidia directly give rise secondary binucleate sporidia which on germination gives rise dicaryotic hyphae and mycelium. The parasitic mycelium is branched, septate and hyphal cells are binucleate. At the time of chlamydospore formation the end cells of the hyphae swell and become globular. The fusion of the two nuclei takes place and finally forms the chlamydospores. At maturity the reticulations on the epispore become more prominent. The chlamydospores develop in the ovaries of the host.

19. Studies in Ustilaginales. 6. Morphology and Cytology of 'Tilletia transvaalensis' on 'Eragrostiella bifaria' Bor.

N. C. JOSHI, Ajmer.

Tilletia transvaalensis has been collected in the ovaries of *Eragrostiella bifaria* from Ajmer.

The spore mass is brownish black and the spores are yellow brown and has the warty epipsore. The mature chlamydospores are diploid and about 70% of the spores germinated when they were first treated with bleaching powder and then kept between 5 to 8°C. for a week and later on kept at room temperature, i.e. 20 to 22°C. The spores on germination give rise long aseptate promycelium and 7 sporidia are developed at the tip. The division of the nucleus takes place in the promycelium. A single nucleus enters in each sporidium and one nucleus remains in the promycelium which later on degenerates. The conjugation tubes develop between two sporidia and the nucleus of one goes into the other and become binucleate which ultimately give rise to the dicaryotic mycelium. The parasitic mycelium now ramifies in the host and in the ovary. The mycelium is intercellular. The hyphal cells soon after swell at the tip and give rise to the chlamydospores. In the earlier stages they become binucleate and become diploid at maturity. The epispore is warty and brown in colour.

20. On Infection of Potatoes in Storage by Certain Fungi and Bacteria.

G. KONGER and H. K. BARUAH, Gauhati.

(1) Different varieties of potatoes in the field and in storage were found to be infected by many species of fungi and bacteria; strains of *Fusarium oxysporum, Fusarium radicicola, Bacterium solanacearum* and *Bacterium carotovorus* have been isolated.

(ii) *Fusarium radicicola* is the most virulent causing greater percentage of infection. The later phase of infection is associated with attack by *Bacterium solanacearum* or *Bacterium carotovorus*.

(iii) The different varieties of potatoes exhibit varying degrees of resistance to attack by pathogens isolated.

(iv) Infection usually takes place more readily through deep wounds than through superficial wounds.

(v) The rotting of the tubers is due to enzymes secreted by the fungus concerned. The enzymes attack the middle lamella and cause loss of coherence of the cells to some extent. The enzymes extracted from *Fusarium radicicola* have been found to attack pectin and cellulose to some extent.
(vi) A method is given to detect wounds which are invisible but are capable of allowing infection.

21. A New Species of Stagnospora on Marsilea Quadrifolia.

R. C. LACY, Allahabad.

The paper describes a species of *Stagnospora* Sacc., parasitic on the petiole and leaflets of *Marsilea quadrifolia,* which was found growing in the temple-pond at Madhubani, Parasnath Hills, Bihar, in the middle of October, 1950.

The leaves showed pale to brown, irregular areas of infection. The central portion bore brown to black, carbonous pycnidia, typical of Phomaceae. The pycnidia were globoid, innate and ostiolate, opening on either surface of the leaf. The infection on the petiole was not so heavy.

Conidiophores were short, arising from the inner parenchymatous wall of the pycnidium and bearing 3-celled, hyaline, oblong to fusoid, muticate, normal conidia with two distinct septa. The hyphae were branched, septate, thin, dark-coloured and mostly intra-cellular.

The fungus was compared with the species of *Stagnospora,* already described and it was found to be different. Therefore, this fungus is being described here as a new species : named *Stagnospora marsileæ* Lacy, according to the fuller details given in the text of the paper.

22. Ultraviolet-induced Biochemical mutants of Aspergillus niger van Tiegnam.

A. K. MISHRA and P. NANDI, Calcutta.

Development of nutritionally deficient strains have contributed greatly to the knowledge of the biosynthetic process and their genetic control. While studying the development of induced mutation in *Aspergillus niger* for the increase of yield of citric acid, a group of nutritionally deficient strains were also obtained.

Irradiation was done with an UV-30 watts germicidal lamp emitting 95% of the rays at 2537 wavelength. The doses administered were calculated from the readings of UV dosimetre. *A. niger* (strain V_{35}) was isolated in this laboratory. The spore suspension was irradiated with different doses and plated out in complete medium containing most of the nutritional factors. The colonies were retested on minimal medium and deficient strains were isolated. By auxanographic test the growth requiring factor of each strain was determined. The number of deficient isolates were 25 out of a total of 1875 strains examined. The following two biochemical mutants are fully characterised :—(1) Para-amino-benzoic acid-requiring, (2) Leucine requiring. Both of them are now established as deficient mutants.

23. Occurrence of Tylostoma in Orissa.

B. PADHI, Cuttack.

A species of *Tylostoma* Pers. was collected in the month of July, 1957 from a sandy waste of Panchupalli, District Keonjhar, Orissa. About 50 sporocarps were growing mostly singly, a few in twos, amidst sparse grass under shade on the bank of a river.

The stipe is 3-5 cm. long, straight, hollow inside, stringy and the upper surface somewhat ridged. The peridium is globoid, erect, rigid, 10-16 mm. in diameter, with endoperidium alone persistent, white and glabrous. The stalk is attached to the peridium inside a circular groove 3-4 mm. in diameter, and 2-3 mm. deep, and it is separable from the peridium. The peridium is furnished with a definite regular mouth, about 1 mm. in diameter prominently pointing upwards.

The gleba is without columella, powdery, with floccose capillitium, and spores entire, spherical, 4-5μ in diameter, echinulate, light brown in colour. The fungus is reported for the first time from this part of India and the definite name would be published later.

24. Toxic resistance of Poria monticola to copper in nutrient medium.

Y. N. PURI and R. P. SHARMA, Dehra Dun.

Poria monticola Murr. a wood-rotting fungus causing brown rot of conifers, has been found to be highly resistant to copper in nutrient medium. Three isolates of *P. monticola* were studied for their toxic resistance to copper, which was taken in the form of copper-resinate, a newly developed wood preservative, and copper sulphate, in 2·5% malt agar medium. Of the three isolates of *P. monticola,* isolate 257 was found to be most resistant to copper. This isolate could grow on malt-agar medium containing up to 0·6% copper in copper-resinate and though unable to grow in a concentration of 0·8% copper, it was not killed even after 14 days' exposure to this concentration. All the three isolates could grow on medium containing 1·6% $CuSO_4$ but were killed between 1·8-2·2% $CuSO_4$. The fungus has the capacity to decolorise the green colour of the medium containing copper-resinate to dull brown.

Poria monticola, particularly the isolate no. 257, presents considerable potentialities for use as one of the test fungi in toxicity tests for the evaluation of wood-preservatives and also in natural durability tests of timbers.

25. Germination of the Sporangia of some Species of Cystopus.

A. C. SAHGAL, Naini Tal.

Germination studies in *Cystopus bliti* (Biv.) de Bary, *C. ipomoeae-panduratae* (Schw.) Stevens and Swingle and *C. candidus* (Pers.) Léveille were carried out in detail. The sporangia were submerged in water using a vacuum pump and observations were made with the help of water immersion objective. The entire process from the formation of a papilla to the discharge of zoospores and their subsequent germination was observed. The sporangia of all the three species germinated indirectly by means of the zoospores. The number of zoospores diminished and the time taken to germinate increased as we proceed from *C. bliti* to *C. ipomoeae-panduratae* and *C. candidus*. In *C. bliti* 8 zoospores were produced regularly and they germinated in 15-40 minutes. In *C. ipomoeae-panduratae,* the number of zoospores produced was 6 and they did not germinate before 40-49 minutes. In *C. candidus* the number of zoospores varied from 4-8 and the time taken was more than an hour. The sporangia in this species had to be chilled at 4°C before germination occurred. The more the chilling was prolonged, the less was the time taken for the sporangia to germinate. The viability of the sporangia at 4°C lasted for a week. An isolated case of germination by germ tube was observed in *C. candidus.*

26. The fate of oospores of Cystopus ipomoeae-panduratae in the intestine of the larva of Omphisa.

A. C. SAHGAL, Naini Tal.

The hypertrophies caused by *Cystopus ipomoeae-panduratae* in *Ipomoea pilosa* and *Ipomoea pestigridis* were a treat for the caterpillar of *Omphisa* sp. Such caterpillars which had fed well on the hypertrophied tissue were made transparent by boiling them in potassium hydroxide solution and mounted in lactic acid. Abundant sound oospores were located in the intestine of the insects. In another set of experiments some caterpillars were allowed to feed on the hypertrophied tissues in the laboratory for about three hours and then fixed in Bouin solution. Microtomed sections, stained in iron alum haematoxylin and picro-indigo carmine, showed large number of oospores in the intestine of insects. As the epispore and endospore of the oospores were found to be intact, it seems that the digestive fluids of the insect have no action on the oospore walls.

27. Spore content of the Sea Air.

T. SREERAMULU, Waltair.

Presence of characteristic spore and pollen population in the air over the inland agricultural and industrial areas has long been recognised. Existing records indicate that spores and pollen in the sea air are scarce. The recent use of power operated suction traps have made it possible to sample air more efficiently to get a quantitatively complete picture of the air spora in any locality. While the author was a passenger on board the P. & O. liner S. S. STRATHMORE, with the kind permission of the P. & O. Company and the cooperation of the commander and the officers of the ship, air was sampled from Gibralter to Malta and Malta to Las Palmas via Gibralter using the 'Imapactor unit' of Gregory's Portable Spore Trap which was connected to the suction port of a compressor working with a D.C. motor. Air was sampled at the rate of 10 l/min. at a height of 70 ft. above the sea level.

The results obtained indicate that sea air is not completely free from fungus spores and pollen. The quantities of each spore type showed great amount of variation and it as observed that there was a gradual decrease in their numbers with increase in distance from the shore. Spores of various familiar pathogenic and saprophytic fungi were found in greater numbers than pollen grains. Although spores of some potential crop pathogens like Smuts, *Alternaria, Helminthosporium* and Uredo-spores of rusts were found to be widespread, they appeared to be relatively sparse when compared with the spores of *Cladosporium*, coloured basidiospores. When the ship was moored inside the harbours of Malta and Gibralter the number of spore types and their quantities per cubic metre of air were very high. Even though higher concentrations of *Cladosporium*, *Alternaria* and other spore types (which are known to have distinct diurnal periodicities) were observed during daytime, basidiospores (which are known to have nocturnal periodicity) were not found occurring in greater concentration during the night time in the sea air and it is interesting to note that *Sporobolomyces* and other mirror yeasts which are known to occur in very high concentrations on land are completely absent. Rainfall was found to wash off spores from the air making it spore free as on land.

Comparison of the spore content of the sea and land air masses shows that many of the spores present in the sea air are of terrestrial origin indicating that oceans do not make any contribution to the air spora.

28. Physiology of micro-organisms.

R. N. TANDON, Allahabad.

The effect of different sources of carbon, nitrogen, trace elements, vitamins and sulpha drugs on about 2 dozen fungi causing leafspot diseases as well as diseases of fruits, vegetables and cereals etc. has been discussed. The manner of utilization of some of the carbon and nitrogen sources has been described.

29. The Thelephoraceae of the Mussoorie Hills—II.

K. S. THIND and K. L. ADLAKHA, Amritsar.

Four new species of Thelephoraceae collected recently from the Mussoorie Hills are described here:—1. *Stereum* (sp. nov.) characterised by laterally stipitate, tough, caespitose fructifications, flabelliform and profusely lobed pileus richly marked by ridges and grooves, and violet grey, smooth, decurrent hymenium. Fruit bodies are 1-4 cm. high and pileus measures 1·5-2·5 cm. in diameter. Its spores are hyaline, smooth, and 2-4 x 1·4-4μ. 2. *Craterellus* (sp. nov.). Fructifications 2·5-3·6 cm. high, centrally stipitate; pileus orbicular, umbilicate, dark violet, marked by multicostate parallel venation, 0·7-2·2 mm. in diameter, with lacerated margin; hymenial surface grayish white, characteristically marked by several large radiating veins, spores smooth, 4-8·5 x 2·6μ. 3. *Craterellus* (sp. nov.) marked by stipitate, fleshy fructifications, 1·5-4 cm. high; light brown circular pileus forming a sort of pouch over the top of stipe, 0·7-2·2 cm. in diameter; cream coloured, slightly ridged hymenium; mostly eccentric stipe; smooth, large spores 6-11 x 5-8μ. 4. *Hymenochaete* (sp. nov.) which is closely allied to *H. semistupposa* Petch but it possesses monomitic hyphae and its setae are much less abundant and are usually not embedded and project out of the hymenial surface by their upper ends.

30. The Polyporaceae of the Mussorrie Hills—IV.

K. S. THIND and M. S. CHATRATH, Amritsar.

This paper deals with two new species and one new variety of Polyporaceae collected from the Mussoorie Hills (5,000 to 7,500 ft. altitude in the North-Western Himalayas) during the rainy months of 1953-54. Two of these belong to *Polyporus* and one to *Fomes annosus* and their chief diagnostic characteristics are as follows: 1. *Polyporus* (sp. nov.) which is very near *P. indicus* Massee but the spores are too small for this. It is also very near *P. poncei* Lloyd but lacks the distinct horny cuticle of this species. 2. *Polyporus* (sp. nov.) characterized by concentrically zonate, applanate, sessile pileus, 1·5-6 x 2-6·5 x 0 4-1·5 cm.; circular pores; dimitic hyphae; and smooth, uniguttulate spores, 2-3·6 x 1-1·6μ. 3. *Fomes annosus* (Fr.) Cke. var. *indica* var. nov. occurring on pine stumps. This is a variety with distinctly smaller pores than those of the species. It has been given a manuscript name var. *indica* by Miss Wakefield in Kew Herbarium. However, it is described here fully for the first time from fresh collections.

31. The Myxomycetes of the Mussoorie Hills—X.

K. S. THIND and P. S. RAHILL, Amritsar.

Four more new species of Myxomycetes collected from the Mussoorie Hills (5,000-7,500 ft. alt. in the North Western Himalayas) during the monsoon months in 1954-55 are described in this paper: 1. *Ceratiomyxa verrucosa* sp. nov. The most striking feature is that its spores are minutely but distinctly verrucose. It is the only record of verrucose spores in this genus, all other records being smooth spored. 2. *Physarum* (sp. nov.) which is characterized by so greenish a colour. Its capillitium is curious, with majority of the nodes being long-fusiform. 3. *Physarum retisporum* sp. nov. It is characterized by the very large stout trabeculate nodes which reach nearly entire width of the fructification, and reticulate-verrucose spores, 9-11μ in diameter. 4. *Didymium* (sp. nov.). The dark, but calcareous stalks and the rather small (9μ) dark, strongly echinulate spores, with a suggestion of a broken reticulum on the surface (due to lines of closely spaced warts) do not fit any known species. It is an excellent and well-matured collection.

32. The Clavariaceae of the Mussoorie Hills—IX.

K. S. THIND and SUKH DEV, Amritsar.

This paper deals with four more new Clavarias from the Mussoorie Hills (5,000 to 7,500 ft. alt. in the North-Western Himalayas). These are described fully and were collected during August and September, 1955-56. Their outstanding characteristics are as follows :—

1. *Ramaria brevispora* sp. nov. which comes nearest to *R. flaviceps* Corner, Thind and Anand (*Trans. Brit. Mycol. Soc.* **39** : 475, 1956) but has shorter spores (5·6-7 × 4-5·4μ against 7-10·5 × 4-5·3μ of *R. flaviceps*). Accordingly the name *brevispora* for the species is quite appropriate. 2. *R. brevispora* sp. nov. var. *albida* var. nov. This fungus undoubtedly belongs to the proposed new species (*R. brevispora*) but its fruit bodies are white in contrast to the yellow ones of the species, hence the var. name *albida*. 3. *Clavulina mussooriensis* sp. nov. is characterised by the possession of emergent hyphae from the hymenium and creamy-white fructification, turning greyish brown with age. In these two respects it differs from *C. cinerea* which it resembles, otherwise, in general appearance. Its emergent hyphae are too narrow to be cystidia of *C. Péveilléi,* in which they are also more or less encrusted. 4. *Clavaria indica* sp. nov. is characterised by the sooty colour of its fruit bodies and by the presence of hypha-like narrow cystidia and it grows under oak forest in caespitose clusters. In all these respects it differs from its close relative *C. purpurea.*

BRYOPHYTA

33. On the Ecological Survey of the South Indian Mosses.

C. SRINIVASAN, Annamalainagar.

Forty different species of mosses comprising eighteen genera were collected from various localities of South India. They have been classified ecologically in the scheme of Gams' classification. No mosses have been found representing the groups Natantia, Epixylia, Exochomophytia and Psammophytia.

Ecological study of the mosses with reference to their climatic factor which includes study of light, temperature, water, humidity and rainfall in two different seasons of the year, has been made. It has been found that these mosses require considerable amount of moisture for their well-being and hence most of them have been growing either at a very high altitude or in regions where there is ample moisture.

A brief survey of the edaphic factor reveals that the substratum usually has a low pH and the mosses grow very luxuriantly on the humus soil where there is sufficient aeration and moist surrounding.

The physiographic factor included the study of the altitude, the latitude of the localities and the amplitude of the mosses that had been growing in associations, consociations and formations. It has been observed that many of these moss societies are usually confined to the high altitudes. But the mosses *Bryum* sp., *Barbula* sp. and *Octoblepharum* sp. are very hardy and they grow quite luxuriantly on the plains of South Arcot on buildings, terraces or rocks during winter and they die down during summer and they subsequently regenerate on the advent of monsoon in October. The symbiotic association of the mosses with the lichens, Jungermaniales, Filicales, Angiosperms and with other mosses have been observed in their biotic factor.

PTERIDOPHYTA

34. A note on Cyclosorus subpubescens (Bl.) Ching, non sensu Ching.

G. PANIGRAHI, Shillong.

Cyclosorus subpubescens is based on *Aspidium subpubescens* Blume, originally collected from Java and described by Blume in 1828. Ching (1938) published the new combination, *C. subpubescens* (Bl.) Ching but erroneously applied it, in its new position, to a different species, *Dryopteris pseudoamboinensis* Rosenstock. This is evident from the examination of the 'type specimen' of *A. subpubescens* Bl. (cf. Herb. Lugd Bat. No. 908337-179 in the Rijksherbarium, Leiden.) and from the comparison of the two different descriptions given by Blume (1828) and Ching (1938), respectively. There is, however, a most misleading specimen, collected by Blume from Java representing *D. pseudoamboinensis* Rosenstock, but bearing a wrong labelling of *A. subpubescens* Bl. in the "type cover" of *D. subpubescens* (Bl.) G. Chr. at the Kew Herbarium (cf. Kew negative No. 2191), presumably because it has also been wrongly determined by Christensen as *D. subpubescens* (Bl.) C. Chr. Ching (1938) not only followed Christensen (1929) but cited 17 synonyms to it and thus added greatly to the nomenclatural confusion in this species. Holttum (1954), while rightly refutes Christensen's interpretation of the true *subpubescens* (Bl.) has, however, accepted Ching's combination and described his Malayan plants under *C. subpubescens* (Bl.) Ching. Hence, in conformity with the Rules it is suggested that the correct nomenclatural position of *A. subpubescens* Bl. should be *C. subpubescens* (Bl.) Ching, non sensu Ching.

35. Somatic Studies in the Genus Adiantum.

R. P. ROY and BAXI M. B. SINHA, Patna.

Cytological studies in fern, in most cases, is confined to the meiotic division in spore mother cells. In very few cases, chromosome morphology and karyotype analysis has been carried out. Even where root-tip counts have been made, detailed information about each chromosome pair is lacking. It is, therefore, with a view to collect as detailed data as possible on the chromosome morphology of the different species of *Adiantum* that the present investigation has been undertaken. Of course, in every case, the data on meiotic studies are also collected. So far several species in this genus have been studied and accounts about some of them have already been published (Roy, and Sinha, 1956, '57). In the present communication, the observations made on the somatic studies are being described. The species which have been investigated include *A. peruvianum, A. capillus-veneris, A. caudatum, A. aethiopicum, A. trapeziforme, A cuneatum* and *A. lunulatum*. All these species contain 2n=60 except *A. lunulatum* and *A. cuneatum* where 2n=90 and 120 respectively, Although the chromosome number is the same in some five species, yet on close examination it is found, that there are some important differences in the individual pairs of chromosomes, namely in *A peruvianum* there are four SAT chromosomes, but in other species investigated here, no SAT chromosomes have been observed so far. However, in each species there are several pairs of chromosomes which have secondary constrictions and look very similar.

From a close study of these chromosomes, it is found that they possess some characteristic structures, i.e., all species have chromosomes with secondary constrictions, and the centromere point, in most cases, is median or only slightly submedian. Thus in having the same somatic number and the chromosomes with median centromere point and the secondary constrictions, these species appear to be common and point to a close phylogenetic relationship. Idiograms of some of the species have been prepared and that of others is in progress.

The species *A. lunulatum* appears to be a triploid having $2n=90$. The somatic number in this species is not 88 as reported by Mehra (1944).

ANGIOSPERMS & GYMNOSPERMS

36. Comparative Morphology and Ontogeny of Foliar Sclereids in Seed Plants. II. Linociera Swartz.

T. ANANDA RAO, Dehra Dun.

The present study describes the salient features of foliar sclereids and their distribution in the mesophyll of 14 species of *Linociera*. Sclereids are the most prominent idioblasts and mostly exhibit diffuse pattern of distribution and rarely do they exhibit apparent terminal relationship with veinlets. Ontogenetic studies have, however, revealed that the initials of the seemingly terminal sclereids arise away from the procambial strands. They are transformed spongy cells in *Linociera insignis* where as in *L. intermedia* and *L. elliptica* they are palisade cells and the apparent terminal appearance is due to juxtaposition or vigorous development near the procambium. Thus sclereids should not be designated as terminal merely on the basis of their position in mature leaf unless this has been compared by an ontogenetic study. On the basis of morphological data, sclereids are divided into six compact types viz., sphero sclereids, osteosclereids, fusiform sclereids, filiform sclereids, astrosclereids and crystalliferous sclereids. The problem of classifying sclereids is discussed and classification of foliar sclereids, based on their ontogeny and general morphology, is emphasized. The function of sclereids as mechanical idioblasts is discussed with other possible physiological functions of Sclereids.

37. Studies on Foliar Sclereids in Dicotyledons. VI. Origin and development of Terminal Sclereids in the leaf of Niebuhria apetala Dunn.

T. ANANDA RAO, Dehra Dun.

An ontogenetic study has revealed that sclereid initials in *Niebuhria apetala* are terminal or sub-terminal to the procambial strand. The origin and sequence of formation of terminal sclereids have been found to coincide with the maturation of veinlets in the young leaf. The sclereids and vein ends follow a distinct combination of centripetal and centrifugal pattern of initiation and maturation.

38. Studies on Foliar Sclereids in Dicotyledons. VII. Origin and development of sclerenchymatous idioblasts in the leaf of Manilkara hexandra (Roxb.) Dubard.

T. ANANDA RAO, Dehra Dun.

The mature leaves of *Manilkara hexandra* exhibit sclerenchymatous idioblasts in close proximity to major veins and veinlets. It is found that the sclerenchymatous initials are nothing but a transformed spongy cells near the differentiating procambial strands.

39. "Studies on the male inflorescence of Trichosanthes bracteata Voigt : I. Anatomy of bracts."

H. L. CHAKRAVORTY Calcutta and P. SENSARMA, Calcutta.

Trichosanthes bracteata Voigt is a scandent herb. Female flowers of the species occur singly at the axil of leaves but the male flowers may be caducous one-flowerd or jugate at the axil of leaves or in a raceme. Each flower of the male inflorescence is protected by a large sessile bract with a broad sheathing base. These bracts are studded with some refractive glands. Anatomy of these bracts with particular reference to the glands has been studied.

The mesophyll is not differentiated into palisade and spongy parenchyme. Three vascular bundles are present in one line at the midrib of which the central one is larger than the two laterals.

The glands are widespread but shallow and cupshaped. These comprise of usual three parts : (i) external excretory tissue, (ii) single layered filter tissue and (iii) supply tissue.

The anatomy of the glands of the bracts of *Trichosanthes bracteata Voigt* gives almost the same picture as that of probract glands of *Coccinia indica* (Linn.) Cogn.

40. Variability in the Radial Pitting in three species of Callitris.

(Miss) C. P. GODAVARI, Annamalainagar.

1. Comparative anatomical studies on the wood of three species of *Callitris* namely *C. oblonga* Rich., *C. calcarata* R. Br., and *C. cupressiformis* Vent., and also seedling anatomy for *C. cupressiformis* Vent., were made.
2. All these three species of *Callitris* were introduced from Australia into various Botanic Gardens of South India at the close of the last century.
3. In *Callitris oblonga* Rich., the callitroid thickening is found occurring in very great abundance both in the primary and secondary wood.
4. In *Callitris cupressiformis* Vent., the thickening has been recorded across a few bordered pits in the primary wood, while Patton and Greguss state that it is completely absent in the specimens examined by them.
5. The seedling anatomy of *Callitris cupressiformis* Vent., reveals fairly abundant presence of the thickening bars in the juvenile wood while its mature wood is almost devoid of this peculiar trait.
6. In Callitris calcarata R. Br., the thickening bands are entirely lacking though Phillips mentions its presence.
7. It becomes evident from the study of seedling anatomy that the presence of the thickening bars is a sign of primitiveness.
8. Accordingly *Callitris calcarata* R. Br., is most advanced and *C. oblonga* Rich., the most primitive while *C. cupressiformis* Vent., occupies an intermediate position amongst the three species studied.

41. The Aerating System of Indian Hydrophytes.

M. V. MIRASHI, Nagpur.

Low availability of air is one of the principal drawbacks of life in water. The water and marsh plants exhibit a number of adaptations to combat successfully with this handicap. Our knowledge of the aerating system of the hydrophytes is mostly based on the study of European species. The paper gives a critical review of the aerating system in the Indian hydrophytes.

The adaptations shown by the Indian hydrophytes for the storage of air are both morphological as well as anatomical. The presence of linear or ribbon-shaped and dissected leaves in the submerged hydrophytes, the location of aerating tissue in the spongy petioles or the cushion-like leaf-bases, the development of secondary flaps of aerating tissue on the stems and the formation of pneumatophores all tend to increase the aeration of the organs of the aquatic plants.

Anatomically, the air-space tissue shows various degrees of development in the Indian Hydrophytes. Although it is very abundant in the vegetative organs of most hydrophytes, the completely submerged species show the development of lacunal even in the fruit wall. In the stems and roots of most of the hydrophytes, the middle cortex serves as the aerating tissue. In others, both the cortex and pith are lacunar. Significant in this connection are those stems where the aerating tissue is entirely and exclusively confined to the pith. Instances of a secondary development of the aerating tissue in the form of the secondary cortex, aerenchyma or aberrant secondary wood are also met with in the stems of the Indian hydrophytes.

Finally, the paper refers to the mechanical arrangements found in the stems for strengthening the fragile aerating cortex the development of a peripheral collenchyma, the formation of diaphragms and the existence of solitary mechanical cells.

In conclusion, there is a discussion on the physiological and phylogenetic significance of the aerating system.

42. Velamen in some Epiphytic Orchids.

B. N. MULAY and B. L. BISHNOI, Pilani.

1. Velamen of four epiphytic orchids viz. *Vanda teres* Lindl., *Dendrobium densiflorum* Wall, *Eria* flava Lindl. and *Coelogyne ovalis Lindl.*
2. The velamen found in these plants show characters like the velamen of terrestrial orchids studied earlier particularly by Mulay *et al.*
3. Two special rows of middle cortical cells occur in *Coelogyne ovalis* for the digestion of fungal hyphae. These cells are larger than the other cells in cortex and have nuclei.
4. Root hairs occur in two epiphytic orchids *Eria flava* and *Coelogyne ovalis*. These root hairs facilitate the entry of mycorrhizal fungus.

43. Root Structure of some Desert Grasses.

B. N. MULAY and R. S. CHUDA, Pilani.

1. The mature root structure of seven desert grasses has been investigated.
2. Hypodermis is uniseriate and slightly thick-walled except in *Panicum antidotale* where hypodermis is absent.
3. Cortical sclerenchyma is present beneath the hypodermis. This cortical sclerenchyma is followed by ordinary parenchyma with prominent intercellular spaces in *Penicum antidtale, Digitaria sanguinalis* and *Setario verticellata* while in *Sorghum halipense, Dactyloctcinum aegypticum, Cenchrus barbaratus* and *Cenchrus ciliaris* show prominent air spaces in cortex.
4. Various theories regarding the cause of formation of air spaces have been discussed. Self destruction of cells as has been suggested by McPherson (1939) and moisture deficiency as pointed out by Henrici (1929) appear to be more probable. At the same time the suggestion of Stover (1928) and Severin (1932) about the mechanical tearing cannot be ignored.

44. Velamen in Terrestrial Monocots.* I. Ontogeny and Morphology of Velamen in Liliaceae.

B. N. MULAY and B. D. DESHPANDE, Pilani.

1. Velamen is the product of protoderm.
2. Majority of the members possess one-layered velamen.
3. In Liliaceae velamen is structurally very simple and is characterised by pits only.
4. Velamen is delimited from cortex by exodermis which has distinct cell wall characters and is composed of long and short cells.
5. Complimentary cells occur beneath the passage cell.
6. Exodermis is sometimes pitted.
7. Fibrous pads occur on passage cells.

45. Floral Anatomy of Garuga pinnata Roxb.

L. L. NARAYANA, Waltair.

The floral anatomy of *Garuga pinnata* Roxb. has been studied.

The flower is typically pentamerous and bisexual. A 'cup' like structure is formed by the union of calyx, corolla and androecium. These separate into the respective structures at the top of the cup. Traces for the petals and antepetalous stamens and sepals and antesepalous stamens arise conjointly. The traces for the antepetalous stamens are demarcated earlier than those situated opposite the sepals and hence the androecium may be described as obdiplostemonous. The ovary is five carpellary, syncarpous, five locular with two ovules in each loculus. The ventral bundles are situated on the septal radii and branches from these supply the ovules. The position and formation of ventral bundles shows that the placentation is parietal. The dorsal bundles split up into a number of small bundles which travel in the wall of the gynoecium. Branches from the ventral bundles also travel towards the periphery and ramify in the ovary wall. The smaller branches, however, fade out earlier than the dorsals and ventrals which continue into the style. The loculi also continue to the top of the style as distinct canals lined by glandular cells.

46. Secondary growth in the petioles of the leaves of arborescent plants and climbers and the Partial shoot Theory of the leaf.

B. SAMANTARAI and B. K. NANDA, Cuttack.

Secondary growth has been observed in the old petioles of some climbers and arborescent plants. In the petioles of the young leaves of *Thunbergia grandiflora* Roxb., and *Derris scandens* Benth. the vascular bundles are arranged in the form of a ring and the cambium is inconspicuous. In the old leaf, the fascicular and interfascicular cambia are well developed and the type of secondary growth is like that in the stem of those species.

Among the arborescent plants the petioles of *Ixora parviflora* Vahl, *Azadirachta indica* A. Juss., and *Moringa pterygosperma* Gaertn., are examined. The secondary growth in *Moringa* is little different but in the rest, the cambium is either rudimentary or absent but in the old leaves well developed fascicular and interfascicular cambia are found. Profuse secondary growth is observed in the petioles and that resembles the type of secondary growth found in the stems. In case of *Moringa*, only the fascicular cambium is well developed and at some regions the interfascicular cambium is developed which produces only ray cells. The type of secondary growth found in these leaves is almost of the same type as found in their respective stems. This supports the partial shoot theory of the leaf elaborated by Arber.

47. Development of Ovule and Gametophytes in Fimbristylis Tenera Roem. & Schult.

M. N. GUPTA, Agra.

The ovule arises as a small protuberance, on a basal placenta, which elongates slightly and begins to bend away from the mother axis. Very soon the rudiments for the integuments appear on it and, by the time the megaspores have developed, the ovule becomes anatropous.

The ovule is crassinucellate and bitegmic and both the integuments are two layered. The inner integument alone forms the micropyle.

A single hypodermal cell represents the archesporium. It cuts off a parietal cell which later on develops into a parietal tissue making the megaspore deep seated. The megaspore mother cell by two reduction divisions gives rise to a linear tetrad of megaspores, of which the chalazal one is functional. The remaining three megaspores degenerate and may be seen in this condition even when the embryo sac is fully organized.

The development of embryo sac is *Polygonum*-type. The antipodals are definite cells and the polar nuclei lie almost in the centre of the embryo sac.

The young anther, which is a homogeneous mass of parenchyma cells, soon becomes four lobed and as seen in transverse section a single hypodermal archesporial cell becomes conspicuous in each lobe.

The wall of the anther consists of an epidermis, and endothecium, one middle layer and a single layer of tapetum. The endothecium develops fibrous type of thickenings while the middle layer and the tapetum degenerate at maturity. The tapetal cells are uninucleate throughout.

The microspore mother cells undergo reduction divisions. No quadripartition of the mother cell takes place and so the four nuclei lie within the mother cell. Out of these three nuclei degenerate and only one becomes functional which increases in size. Wall formation between the functional nucleus and the three non-functional nuclei as well as the septa between the latter do not seem to be present in this material.

The functional nucleus divides into a large vegetative and a small generative cell. The pollen grains are bicelled at the time of shedding but occassionally the generative cell divides before shedding stage.

48. Embryology of Oxalidae.

L. L. NARAYANA, Waltair.

The embryology of *Oxalis tetraphylla* Cav., *Oxalis pubescens* H. B. and K., *Oxalis variabilis* Lindl., *Oxalis latifolia* H. B. and K., *Oxalis pes-caprae* Linn., *Oxalis corymbosa* Dc and *Biophytum intermedium* Wight has been studied.

The primary archesporium in the anther in *Biophytum intermedium* consists of a plate of 3-4 cells. The anther structure shows an epidermis and three wall layers of which the innermost develops into the secretory tapetum the cells of which ultimately become 2-nucleate. A fibrous endothecium is developed from the hypodermal wall layer. Cytokinesis takes place by furrowing. Pollen tetrads are tetrahedral in arrangement. The pollen grains are 3-porate and are 2-celled at the shedding stage.

The ovules are tenuinucellate and bitegmic. The integuments are free from one another. The micropyle is formed by both the integuments.

The primary archesporium in the ovule is hypodermal and single celled. A multicellular archesporium has been frequently observed. The archesporial cell directly, becomes the megaspore mother cell without cutting off a parietal cell. The development of the embryo sac follows the normal type.

In *Oxalis variabilis* the ovules after the differentiation of the archesporium show arrested development. The archesporial cells do not develop further. But the integuments grow as usual and form the micropyle. As a result of this a space is enclosed between the integuments and above the cells of the nucellus which become deeply stained. These cells give a false impression of a hypostase.

In *Oxalis latifolia* abnormal embryo sacs have been observed in two ovules. The micropylar end of the embryo sac at the two nucleate stage becomes elongated and projects through the micropyle.

The endosperm is free nuclear.

The development of the embryo has been studied in *Oxalis pubescens* and *Biophytum intermedium*. In both species it follows the Asterad type and keys out to *Oxalis* variation.

49. Overgrowth of the Scutellum of the Grass Embryo in Culture.

S. NARAYANASWAMI, Delhi.

The paper deals with investigations on the physiological and morphological functions of certain growth substances on embryos and the histological changes brought about in embryos cultured in vitro. Young and immature embryos of cultivated cereals like *Pennisetum typhoideum* Rich., *Hordeum vulgare* Linn., *Avena sterilis* Linn., var. *Kulla* and *Triticum vulgare* Villd., were excised from the confines of the caryopses aseptically. These were grown on White's basal medium (used as the control) and White's solution supplemented by various growth chemicals and adjuvants like tomato juice, using the Tissue Culture techniques.

On liquid media containing adenine—20, 40 and 60 mg/l, exuberant growth of the scutellum of *Pennisetum* embryos was repeatedly observed in all the subjects treated. The scutelli grew as tumorous tissues of abnormally large size forming mounds and depressions on the outer surface bounded by the epithelial layer. The embryonal axis, however, was inhibited in growth. Adenine supplemented by exogenous supply of low concentrations of IAA augmented the scutellar overgrowth, causing it to assume bizarre shapes.

Histological changes brought about in such atypical growths have been studied.

Ovary cultures have been done using kinetin, adenine etc., and the growth pattern of embryos dissected out of such ovaries have been recorded.

50. "Nuclear endosperm" or "Non-cellular endosperm"?

V. S. RAO, Bombay.

The term "nuclear endosperm" which has established itself in botanical literature, and also the terms "coenocytic endosperm" and "non-cellular endosperm" are discussed with reference to their appropriateness. It is suggested that the term "non-cellular endosperm" is more appropriate than "nuclear endosperm".

51. Embryological Studies in Menispermaceae II.

R. L. N. SASTRI, Waltair.

This paper deals with the embryology of *Cissampelos pariera* L., and *Stephania hernandifolia* Walp., and endosperm, embryo and seed development in *Tinospora cordifolia* Miers, and endosperm and seed development in *Cocculus villosus* DC.

The mature anther wall is five layered of which the innermost forms the tapetum of secretory type in *Stephania* and of peri-plasmodial type in *Cissampelos*. The endothecium is fibrous. Mature pollen grains are tricolpate and two celled.

Of the two ovules in a carpel only one reaches maturity while the other degenerates usually at the megaspore mother cell stage or even later. The ovule is unitegmic, hemianatropous and has a nucellar cap. There is a single, hypodermal primary archesporial cell which cuts off a primary parietal cell in the young ovule. The embryo sac development conforms to the Polygonum type. The antipodals persist till the time of fertilization and show egg-like structure in *Cissampelos*. The polar nuclei fuse before fertilization. The embryo sac is short and broad in *Cissampelos*. The endosperm is of nuclear type in all species studied. First the nucellus and later the endosperm become ruminate due to the infoldings of the integument. In *Tinospora* the infoldings are restricted to the side adjoining the funiculus. In *Cocculus, Cissampelos* and *Stephania* the ruminations are not so pronounced but the seed coat becomes wavy. In these plants the fruit wall also becomes wavy on the inside corresponding to the waviness of the seed coat.

Embryo development conforms to the Onagrad-Type and keys out to the *Trifolium*-Variation which is characterized by the presence of a suspensor and an epiphyseal initial, in all species. In *Tinospora* the zygote divides only after the fruit is full grown and the embryo is displaced to a lateral position during seed development. These two circumstances probably account for the difficulty experienced by the earlier authors in locating the proembryo in this plant.

The fruit wall is made up of an epidermis, an outer fleshy zone of 6 or 7 layers of parenchymatous cells and an inner zone of longitudinal and transverse fibres. The seed coat is very much reduced and consists of two or three layers of crushed parenchymatous cells.

52. Embryology of Cephalotaxus drupacea var. pedunculata.

DHANWANT KAUR, Amritsar.

Different stages in the life-history of the species have been investigated from the material collected at the arboretum of the F. R. I. Dehra Dun. The archesporium is deep seated in the nucellus and its cells are not much differentiated from the rest of the nucellar cells. A single megaspore mother cell is organised. A linear 'tetrad' is formed but the upper diad mostly remains undivided. The lowermost megaspore is functional. The cell wall formation in the embryo sac appears to be of the alveolar type. 3—6 archegonia are usually organised. Each archegonial initial is superficial in origin. Neck is constituted of upto 4 cells arranged in a single tier but occasionally there may be two tiers. The mature archegonia are long pointed at the bottom. A ventral canal nucleus is organised but becomes evanescent before fertilisation. The archegonia become embedded by the overgrowth of the surrounding gametophytic tissue. Occasionally an archegonial complex of five archegonia is observed.

Normal pollen grains are shed at the two 'nucleate' stage. There is no vegetative cell. A generative cell is organised before dehiscence of the pollen. Further growth occurs on the ill-formed pollen chamber at the apex of the nucellus. The pollen tube is broad and unbranched. A stalk nucleus is formed and the body cell divides to form two unequal male nuclei; often the inequality is marked. The pollen tube may reach the archegonia before they get embedded but in cases of late germination of grains, the pollen tube is observed to bore through the overlying tissue to reach the venter.

Besides the normal pollen grains, abnormal pollen is also observed even in the same cone. These abnormal grains may contain micronuclei and are formed through irregular meiosis of the mother cells which may form polyads instead of the regular tetrads. These grains are non-functional.

Simple polyembryony is the rule. The first division of the fertilised egg occurs in 'situ'. Thereafter three successive divisions result in a 16-nucleate stage. The nuclei are located in the basal one third region of the egg. In the upper region a few irregular and unequal nuclei are formed through the amitotic division of the second male nucleus. These ultimately abort. Cleavage around the embryonal nuclei results in the formation of not very regular four tiers. The uppermost rosette tier is walled and gives rise to rosette embryos. This is followed by the suspensor and the embryonal tiers. The terminal one gives rise to the deciduous cap. The structure of the cap is very variable. It may be formed of a single large pointed cell or there may be in addition one or two layers of smaller cells behind. In rare cases the cap persists at an advanced stage of embryo development. Parts of the primary suspensor or even the secondary suspensor may become closely septate in abnormal cases and may even proliferate to give rise to secondary embryos which, like the rosette embryos, lack a cap. Occasionally budding from the primary embryos (embryonal mass) is observed. In the mature embryo, the shoot apex is flat and is the last region to be differentiated. There are two cotyledons.

Affinities of the genus are discussed.

CYTOLOGY AND GENETICS

53. Studies on inducing polyploid flower plants and their utilization. I. Iberis amara L.

P. N. BALI and S. L. TANDON, Delhi.

The present paper is concerned with the work done on colchicine-induced polyploidy in *Iberis amara* L. Treatments given to growing points of young seedlings with 0·10 and 0·20 per cent aqueous solution of colchicine for 6 and 12 hours gave best results from the point of view of survival of seedlings and induction of polyploidy. The tetraploid was larger in every morphological comparison made than its diploid progenitor. The stomata and pollen grains of the tetraploid were also bigger than those of diploid. The number of stomata per unit area in the tetraploid was, however, less than diploid. The percentage of pollen fertility was very high in the diploid as well as tetraploid. There was practically no difference in fruit setting between the 2n and 4n plants. Although the number of ovules per ovary was 2·0 in both the cases, the average number of seeds per fruit was 2·0 and 1·2 in diploid and tetraploid respectively. Seeds of the tetraploid were, however, much larger and heavier than those of the diploid.

The presence of conspicuously large flowers in the artificially-induced tetraploid *Iberis amara* L. suggests a possibility for selection of a desirable type for introducing in the horticultural trade. Although the fertility of the tetraploid was rather low, this handicap could be easily overcome by leaving a larger number of plants for seed collection.

54. A comparison of some of the flowering characters of the parents and their Hybrids—Datura Inoxia Mill. Brugmansia Suaveolens Humb. & Bonpl. and D. Inoxia Mill B. Aurea Saff.

P. C. JOSHI, Chandigarh.

Reciprocal crosses between the species of *Datura* and *Brugmansia* (Tree Daturas) are ordinarily incompatible. It was, however, observed that some fruits developed on *D. inoxia* Mill. plants when crossed with *Brugmansia suaveolens* Humb. & Bonpl. or *B. aurea* Saff., but no viable seeds were ever formed. Some of the capsules resulting from these crosses developed a few immature embryos which left on the plant died after sometimes. Some of these hybrid embryos, before they started disintegrating were dissected out of the capsule and were cultured *in vitro*. In this way the two intergeneric hybrids, *D. inoxia* × *B. suaveolens* and *D. inoxia* × *B. aurea* were obtained.

A comparison was made of the following well contrasted flowering characters of the parents and the hybrids :—(1) the flowering periodicity, (2) the period for which the flower stays open, (3) rate of increase in corolla length, (4) change in the position of flower, (5) persistence of ovary of the unpollinated flower. In flowering periodicity the hybrids resemble more the *Datura* parent. The hybrids are intermediate between the parents for the duration of the opening of the flowers and the rate of increase in corolla length. The hybrids resemble the *Brugmansia* parents in the change in position of the flower axis during its development and early falling off of the ovaries of the unpollinated flowers without undergoing any enlargement.

55. Certain rare radiation-induced chromosomal abnormalities.

(Miss) MARY KORAH, Calcutta.

Two very rare and interesting chromosomal aberrations have been recorded in the course of an investigation on the modifying factors in induced mutagenesis.

The first is the occurrence of ring-like metaphase chromosomes in the root tip mitosis, from the desiccated seeds of *Oryza sativa* L., treated with various doses of Xrays. In this case, the ends of the chromosomes have been found to remain unseparated for a long time. The phenomenon has been explained on the basis of alteration of the cycle of division of the four different regions within a chromosome. The presence of these separate regions in a chromosome have been established by Lima-De-Faria (1956) in *Allium cepa*.

In another case where the seeds were exposed to oxygen for a period of 24 hours and later irradiated with X-rays, an extremely rare case of interlocked bridged was recorded. The occurrence has been explained on the basis of translocation following breakage of two chromosomes leading to the formation of a decentric chromosome. It has been suggested that a full turn of the chromatids about one another will give rise to such a condition. Similar bridges have been recorded in X-irradiated Grass Hopper (Carlson, 1953).

Other possible explanations of the two conditions described above have been enumerated and discussed.

56. X-ray induced morphological mutants of economic value in Til (Sesamum orientale).

U. K. RAI and K. T. JACOB, Bose Institute, Calcutta.

In oil-seed crops, the selection of higher oil yielding plants in the field, is rather a difficult problem for the plant breeder, as, those with greater number of fruits and seeds may give a lower oil content. Therefore, if it is possible to correlate the character of higher oil content with some other visible characters of the seeds such as, seed size and colour, weight, maturity, or others like pigmentation of plant parts, root habit etc., it may be easier to make the selections for higher yield in the field itself. For this, induced mutagenesis may be very useful, since it produced wide genetic variability giving rise to number of morphological variants in its progenies and hence it may be possible to correlate the higher oil content with changes in the morphology of the plant, as mentioned above.

The present paper deals with the characteristics of two recessive X-ray mutants, one a "white flowered" mutant, isolated in the X_8 generation from the 50 m.a.H. treatment in 1952 and the other a "small seeded" mutant, isolated in the X_4 generation from the 36 m.a.H. treatment in 1953, in til (*Sesamum orientale* type 16, from West Bengal). The white flowered mutant gives nearly 6 p.c. and the small seeded mutant, 26 p.c. more yield of oil, over the control type 16. No marked change between the oils of mutants and control in, colour, refractive index, saponification value, iodine value, p.c. non-sap and mixed fatty acids, have been recorded. Oils of the mutants with lower peroxide value show better keeping quality than the oil of the control type 16. The small seeded mutant is 1·2±0·33 days earlier also, than the control, in flowering. The beneficial effect of X-rays in inducing the morphological mutants of economic value has been discussed.

57. Preliminary observations on the influence of X-rays on the somatic chromosomes of Urginea indica Kunth.

K. RANGASWAMI AYYANGAR, Annamalainagar.

Previous work in this laboratory has shown that irradiation of the bulbs of the Indian Squill, *Urginea indica* Kunth. with ultra-violet rays brings about appreciable changes in the mitotic mechanism of the somatic nuclei in the root tip cells. The present work records the influence of X-rays upon the mitotic chromosomes of this plant. The plants were subjected to X-rays from a Coolidge tube operated at 45 KVP and 2·4 mili-amps., the target distance being six inches.

The impact of X-rays has affected only those nuclei which were actually in the process of division, especially in the anaphasic stages. Obviously irradiation has no effect on telophasic nuclei which have already undergone division. Fragments are formed, some of which being distal and acentric, lag for sometime and ultimately get disorganised at the close of mitosis.

A few of the proximal fragments possessing the centromere, give rise, by end-to-end fusion, to dicentric chromatids which, during anaphase, become stretched into chromatin bridges. In a few cells, chance union of both the fractured ends of one and the same chromosome has resulted in the formation of chromatin rings.

The possibility of chromosomal fragments caused by ionising radiations resulting in yet newer, morphologically distinctive varieties through perpetuation in succeeding mitotic cycles, has been indicated.

58. A Semi-Asynaptic Plant of Hibiscus Esculentus L.

R. P. ROY and R. J. JHA, Patna.

In a field of *Hibiscus esculentus* L. in 1956 one plant showed luxuriant vegetative growth. This plant could easily be singled out in the field because of its tall size, bigger and thicker leaves and numerous branches. This plant was therefore closely watched and when flowers appeared, they were examined.

On examination of anthers and pollen grains the percentage of good pollen as determined by their strainability in Acetic Carmine was much below 50%. In spite of high percentage of pollen sterility the plant produced fruits regularly—

rather it bore larger number of fruits than the normal plants in the same field, although the size of the fruit was slightly smaller than those in the normal ones. The plant survived for a long time. All the normal plants died by November 1956 but this plant continued to grow till May 1957 and went on producing fruits. The fruits appeared quite normal from outside but they were empty. No mature seeds were formed in them. Out of a large number of fruits that this plant produced, hardly 12-13 seeds were obtained which also, later on, showed that they had no embryo in them and hence did not germinate.

The plant was then cytologically investigated. Pollen mother cells from different flower buds were squashed in Acetic Carmine and meiotic stages were studied. At first metaphase an average of 43 bivalents per nucleus were regularly found on the equatorial plate and 46 univalents remained scattered irregularly towards both the poles. In some nuclei, however, all the chromosomes remained as univalents and by the time first anaphase commenced, each of them divided in two, looking as 264 units. By the time tetrads were organized, several micro-nuclei were seen in each pollen mother cell. In normal species sixty-six bivalents are regularly formed at first metaphase and the tetrads and pollen grains are normal.

In order to find out whether this semi-asynaptic condition is only on the male side or also in the embryo sac mother cell, some six flowers were pollinated artificially by pollen grains from the neighbouring normal plants. Fruits were formed in these flowers but no seeds were found in them also. This showed that no viable eggs were formed in the plant and hence the plant was both male and female sterile. It has been discussed that this semi-asynaptic condition is not due to non-homology of chromosomes but due to mutation of a gene which controls the pairing of chromosmes. The formation of apparently normal fruits is presumably due to the stimulus received from the penetration of pollen tubes from the normal looking pollen grains through the style. Hence the ovary wall develops into fruit as a parthenocarpic one. This, is the first report of a semi-asynaptic plant in this important vegetable, *Hibiscus esculentus.*

59. Pachytene Studies in Mnisethea Perforata, Linn.

R. P. ROY and D. N. SINGH, Patna.

The study of pachytene chromosomes in *Mnesithea perforata,* L. has been carried out and it reveals that there are dark staining and light staining regions on each arm of every chromosome. These regions have been named as chromatic and achromatic after Brown (1949). The differentiation of each arm into chromatic and achromatic parts is presumably due to actual minute structural differences and is therefore intrinsic. The nine pairs of chromosomes in this species show the distribution of the chromatic and achromatic parts in different sequence. In some chromosomes the dark staining part is just on the two sides of the centromere, whereas in others this is not so. Similarly there are several distinct small patches of chromatic regions in some chromosomes but in others there is only one big chromatic region near the centromere. Thus the nine pairs seem to have their own characteristic pattern of chromatic and achromatic regions. The two regions in each chromosome have been measured in microns armwise and their ratio has been determined. The chromatic portion in every case occupies a much smaller part of the arms than the achromatic. Each pair of chromosomes can, therefore, be distinguished at the pachytene stage on the basis of this structural differences. It has been discussed that besides using the Karyotype analysis of the somatic chromosomes, the study of pachytene chromosomes can also prove useful in cytotaxonomical investigation. In addition, the data on the chromatic regions which corresponds to Heitz's terminology of heterochromatic parts, may be used to indicate the total out-put of the polygenes. It would be worthwhile to investigate whether long chromatic regions implying greater polygenic contents show greater continuous variations and consequently greater adaptive power of the species in natural selection. Further work on the related species of the group *Rottboellastraeae* is in progress.

60. Basic Chromosome number in Crotalaria Sericea Retz.

R. P. ROY and R. P. SINHA, Patna.

In the genus *Crotalaria,* most of the workers have reported the basic chromosome number to be 8 or multiples of 8. But sometimes for some species basic number as 7 or 10 (Atchison 1950, and Dutt 1933) have also been reported. Therefore, there appears to be no unanimity about the basic chromosome number in this genus. Cytological investigation was, therefore, undertaken to clarify this point. For the sake of investigation, a wild species, *Crotalaria sericea* Retz. was preferred to those that are cultivated or semi-cultivated because in the latter cases cytological irregularities are to be expected. Hence from the point of view of the present investigation such species would not be desirable. On the other hand, *Crotalaria sericea* is a wild species and grows around Patna and has not been investigated so thoroughly as other species. Meiosis was, therefore, studied in this species from plants growing wild in the different localities of Patna. The meiotic studies show that in large number of nuclei the division is regular i.e., 8 bivalents are formed and they separate regularly. But there is non-synchronisation in the stages of division in the different pollen mother cells, some showing diakinesis, others first metaphase and still others late anaphase to early telophase within the same anther. At diakinesis one bivalent looks like a ring and can, therefore, be distinguished from other bivalents. In quite an appreciable number of nuclei, one bivalent remained as laggard with the result that in the two daughter nuclei only seven chromosomes are included. The lagging bivalent separates very late and the separated complements may or may not be included in the two daughter nuclei. There is thus a source of origin of aberrant gametes with hypo- or hyper-number of chromosomes than 8. It has been pointed out in the text that such aberrant gametes need not necessarily be non-viable. Instead, they may give rise to plants with different chromosome number in the natural population, the majority of plants, of course, having $n = 8$. It is discussed that $n = 10$ as reported by Dutta (1933) may be due to the investigation of an aberrant plant produced from abnormal gametes. Thus from the observations made by other workers in this genus and the present investigation in *C. sericea,* one is inclined to accept eight as the basic chromosome number in this genus. Other basic numbers reported from time to time may be due to the study of aberrant plants in the population.

61. Chromosome Studies in Palms.

SANTOSH KUMAR SARKAR, Calcutta.

The present paper deals with the cytology of five species of Palms distributed under three genera. This is a continuation of the previous communication on Palms (Sharma and Sarkar, 1956) worked out with the aid of the same method (Sharma and Sarkar, 1955) showing the use of aesculine as a pretreatment chemical and staining through Orcein schedule.

The chromosome numbers of the different species which have been cytologically studied are as follows :

Cocos comosa Mart.	2n=32
C. australis Mart.	2n=32
C. Romazoffiana Cham.	2n=32
Areca madagascariensis Mart.	2n=32
Zalacca edulis Blume	2n=28

Most of the chromosomes of the complement are medium to short in size with median to submedian constrictions. Considerable amount of alterations of chromosome complements in the somatic tissue of each individual has been noted. Each and every species can be distinguished on the basis of their Karyotypes.

62. Linkage Groups in Cowpea (Vigna sinensis, Savi).

NIRAD K. SEN and J. G. BHOWAL, Kharagpur.

Inheritance of six pairs of contrasting characters in cowpea, not reported before, were studied in three crosses. It was observed that (1) "Swelled stem base" is dominant over "Normal stem base"; (2) "Purple branch base" is dominant over "Green branch base"; (3) "Purple calyx" is dominant over "Green calyx"; (4) "Whole seed color" is dominant over "Holster eye color"; (5) "Black seed color" is dominant over "Salmon seed color" and (6) "Salmon seed color" is dominant over "Brown seed color, inheritance being monogenic in all the contrasting characters.

Previously reported inheritance of the following characters that (1) "Violet flower" is dominant over "Tinged flower"; (2) "Green fruit color" is dominant over "Yellowish green fruit color"; (3) "Purple fruit tip" is dominant over "Green fruit tip" and (4) "Smooth fruit surface" is dominant over "Wrinkled fruit surface", was confirmed.

Estimate of the recombination fraction from the F_2 frequencies, according to Fisher's (1921) formula of maximum likelihood, indicates the following linkage groups :

Gr. I : Flower color (Violet-tinged)—Eye color (Whole holstein)—Fruit surface (Smooth-wrinkled)—Seed color (Salmon-brown).

Gr. II : Branch base (Purple-green)—Fruit tip color (Purple-green)—Seed color (Black-salmon)—Calyx color (Purple-green).

The characters "Stem base" (Swelled-normal) and "Fruit color" (Green-yellowish green) are not in any of these two linkage groups.

63. Breeding Tetraploid Green Gram—C_1, C_2, C_3 and hybrid generations.

NIRAD K. SEN and A. K. GHOSH, Kharagpur.

Tetraploids of four kharif and two rabi green gram types were obtained by treating the apical buds of the seedlings with 0·25-0·5% colchicine solutions for 1, 3 and 6 hours repeated for 1-3 days. Seed treatment with colchicine solutions for different durations gave very few tetraploids. The seeds of the individual tetraploids (C_1) were grown for two successive generations (C_2, C_3). The C_2 tetraploid plants of different types were hybridized and a comparative study of all the generations were made by growing them side by side.

In the tetraploids the plants were much taller with practically same number of branches; leaflets were smaller, but broader in 3 types, thicker, with larger stomata, reduced in number per unit area. Flowers and all floral parts were larger and more flowers were borne per inflorescence. Pollens were larger and semisterile (25-30% sterility). Fruit setting was reduced (except in type NP 28) as well as the number of seeds per pod, but the seed weight increased. Total yield per plant ranged from practically sterile tetraploid line Chinimung to 75% of the diploid in NP 28.

Hybrids of 3 crosses of tetraploids were more vigorous and fertile than their parents except in the cross 4N(NP 28 x 4441-D-1), where the yield of the hybrid was less than that of NP 28.

Meiosis in tetraploids was more or less regular with few quadrivalents. Plants of C_1 generation were mostly chimeras and except for the fertility there was not much difference in C_1, C_2 and C_3 generations.

64. Studies in Colchcicine Induced Tetraploid Horse Gram (Dolichos biflorus L.).

NIRAD K. SEN and R. V. VIDYABHUSAN, Kharagpur.

Seeds and seedlings of four types of horse gram were treated with aqueous colchicine solution of various concentrations and durations to induce tetraploidy. The seed treatment failed completely to induce tetraploidy, but a good number of tetraploids were obtained by treating the growing shoot apex. The tetraploid plants in C_1 generation developed thicker and broader leaves, with bigger but fewer stomata. Flowering was delayed by 2-4 days, but the duration was prolonged considerably. Floral parts were slightly bigger. Pollen size and shape were much variable and 50-80% of the pollen were stainable. Fruit setting, pod size and the number of seeds per pod were reduced, but the seeds were bigger.

65. A Cytological Investigation of two Species of Brunfelsia.

ARUN KUMAR SHARMA and ARYA KUMAR BAL, Calcutta.

The paper reports the cytological observation on the two species of *Brunfelsia*. Karyotype analysis has been performed with the aid of improved methods, involving the use of Aesculin, and the chromosome number noted in *B. americana* is $2n = 22+2F$ and in *B. grandiflora* $2n=22$. In addition to general similarities in karyotype, which suggest their affinities, minor differences in the chromosome morphology of the two are noticeable. This fact not only indicates that the two species can be identified on the basis of their karyotype, but at the same time suggests a possible role of structural alteration of chromosomes in the evolution of species.

Variations of chromosome complement, both structural and numerical, in the somatic cells have been noted to occur constantly in all the individuals, in which the normal complement is present in the highest percentage of cells. In *B. americana* though in the P.M.C. 22 chromosomes have been found as recorded previously too, no evidence of 22 chromosomes have been found in the somatic cells so far observed, and 22+2F chromosomes have been found in the majority of the somatic nuclei. Investigations are in progress to work out how the fragments once becoming eliminated in the germ line, again appear in the somatic cells of the next generation.

Variation in chromosomes number in the somatic nuclei has been recently demonstrated to have a great role in speciation in vegetatively reproducing plants, but the significance in a sexually reproducing genus like *Brunfelsia*, is yet to be investigated.

66. Inconstancy in chromosome complements in species of Maranta and Calathea.

ARUN KUMAR SHARMA and NRIPENDRA KUMAR BHATTACHARYYA,
Calcutta.

1. Nine different species of the family Marantaceae distributed under two genera *Calathea* and *Marenta* have been cytologically studied. The chromosome numbers counted for the different species are :

(i) *Calathea leopardina* Regel	$2n=8$
(ii) *C. vandenheekei*	$2n=22$
(iii) C. zebrina	$2n=22$
(iv) C. princeps	$2n=22$
(v) C. ornata	$2n=26$
(vi) Maranta insignis	$2n=26$
(vii) M. picta	$2n=26$
(viii) M. leuconeura	$2n=26$
(ix) M. kegeljani	$2n=33$

2. Detailed karyotype studies of all these species have been made. On the basis of cytological data, interrelationship between the two genera as well as their present taxonomic status has been discussed. Species with $2n=8$ chromosomes have been considered as representing the most primitive condition.

3. Evidence of structural changes of chromosomes playing a role in speciation has been gathered specially from their karyotypes.

4. The significance of variation in chromosome number in different individuals of the same species, on the basis of the report of previous as well as the present one, has been discussed in relation to the origin of chromosomal biotypes in nature.

5. Occurrence of structural and numerical alterations in the somatic complements of different species has been noted. In view of ineffective sexual reproduction, their importance in the origin of biotypes and species through vegetative reproduction has been pointed out.

67. Further Investigation on the Cytology of Different Species of Amaryllidaceae.

ARUN KUMAR SHARMA and Miss MIRA JASH, Calcutta.

1. A cytological investigation of the somatic chromosomes of five different species under four genera of the family Amaryllidaceae has been carried out. The following are the names of the species investigated :

(i) *Hippeastrum reticulata* L. Herit	($2n=22$)
(ii) *Zephyranthus verecunda* Willd.	($2n=22$)
(iii) *Amaryllis belladonna* Linn.	($2n=22$)
(iv) *Amaryllis Snow-Queen*	($2n=44$)
(v) *Imantophyllum miniatum* Hook.	($2n=22$)

Somatic chromosomes of these species have been worked out in detail. All of the above-mentioned species contain multiples of eleven.

2. Taking into account the previous data as well as the present investigation of all of them, they are supposed to represent a single polyploid series.

3. The systematic position of the different genera are criticised cytologically and they are placed under their respective different genera, bcause though the complements contain multiples of eleven, the morphology of their chromosomes do not show enough similarity to include them under a single genus. It is supposed, however, that they all represent a branch line from a common stock in evolution.

4. Affinities with the other members of the family Amaryllidaceae have been discussed.

5. Karyotypic alteration and its significance in the species where sexual reproduction is practically absent is also discussed. The variation in number as well as in structure in the chromosome complement is a constant feature among the investigated members where vegetative propagation is the sole means of reproduction. It is supposed that these altered nuclei have given rise to the new varieties and genera and thus speciation among them takes place.

68. Chromosome Studies as a means of detecting the method of speciation in some members of Liliaceae.

ARUN KUMAR SHARMA and ASOKE KUMAR CHATTERJI, Calcutta.

1. A cytological investigation of the chromosomes of seven different species belonging to five genera of Liliaceae has been carried out, namely,

1.	*Anthericum picturatum*	$2n=28$
2.	*Dianella variegata*	$2n=28$
3.	*Aloe vera* Linn.	$2n=14$
4.	*Funkia aromatica*	$2n=20$
5.	*F. lancifolia* Spreng.	$2n=60$
6.	*Chlorophytum elatum* R. Br.	$2n=28$
7.	*C. nepalense* Baker	$2n=56$ & 42

2. With the aid of the recently improved techniques detailed karyotype study has been done in all of them except in *Funkia lancifolia*. Species of *Anthericum, Chlorophytum* and *Aloe* show the chromosome number as multiples of 7, and species of *Funkia* reveal their basic number as 10, while *Dianella variegata* showing 28 chromosomes may be a derivative of the basic number 8 shown by other species of the genus.

3. Meiotic studies have been carried out in *A. picturatum, D. variegata, F. lancifolia* and *C. nepalense* and in all of them, high frequency of irregularities have been noted, including the multivalent formation in *D. variegata* and *C. nepalense*.

4. Role of polyploidy in the evolution within the genera has been emphasized. High polyploid types have been noted in *C. nepalense* and *F. lancifolia.* The present report coupled with the previous records show that both auto- and allopolyploidy have contributed to the speciation within these genera.

5. It has been regarded that along with polyploidy structural changes of chromosomes have played some role in speciation and this is well-marked in case of *Aloe vera.*

6. In addition to this, cells with varying number of chromosomes have been noted in the same root tip tissues. On the basis of other corroborative data from previous work on the importance of such irregularities, it has been inferred that such cells possibly take part in the formation of bulbs with new genomic constitution and thus help in their speciation

69. Investigation into the cytology of some Members of Convolvulaceae as an Aid in understanding their Lines of Evolution.

ARUN KUMAR SHARMA and ASOKE KUMAR CHATTERJI, Calcutta.

1. A cytological study of seven different species, of the family Convolvulaceae distributed under seven genera has been carried out. The following are the names of the species, with their 2n numbers, investigated :

1.	*Evolvulus nummularius* Linn.	2n = 24
2.	*Merremia emarginata* Hallier.	2n = 28
3.	*Porana paniculata* Roxb.	2n = 26
4.	*Hewittia bicolor* Wight and Arn.	2n = 30
5.	*Jacquemontia violacea* Choisy	2n = 18
6.	*Argyreia argentea* Arn, ex. Choisy.	2n = 28
7.	*Cuscuta reflex* Roxb.	2n = 42

2. Detailed karyotype has been done in all of them except *C. reflexa*. The normal somatic number is different in different species; but the number 28 is shown both by *M. emarginata* and *A. argentea*. There is a gross similarity in chromosome morphology, which are very small, of *E. nummularius*, *M. emarginata*, *H. bicolor* and *P. paniculata*.

3. Meiosis has been studied in *E. nummularius*, *M. emarginata*, *Hewittia bicolor*, *J. violacea*, *C. reflexa*. Meiosis has been found to be regular in all of them, except in *C. reflexa*, showing high degrees of irregularities.

4. Role of polyploidy, aneuploidy and structural changes operating in the evolution of the species has been emphasized. Numerical alterations in chromosome numbers has been considered as not being affected much in selection as compared to members of other families.

5. Four different cytological lines of evolution have been suggested within the genera studied. Each of the species, *C. reflex*, *J. violacea* and *A. argentea* are representatives of different lines of evolution; while *E. nummularius*, *M. emarginata*, *P. paniculata*, and *H. bicolor* along with species of *Ipomoea* are supposed to have arisen from a single common line. The genus *Cuscuta* with its unusually large size of the chromosomes and symmetrical karyotype has been considered as representing one of the oldest group in the family.

70. Effect of Asparagine on Plant Nuclei.

ARUN KUMAR SHARMA and ASOKE KUMAR CHATTERJI, Calcutta.

1. An investigation has been carried out to note the effect of the amide asparagine, a normal metabolic product, on the somatic tissues of plants. Different concentrations were applied for different periods to work out the differential effects.

2. Of the various effects noted, the noteworthy are the induction of division in the nuclei of mature tissues revealing the polytechnic condition of the chromosomes, applied in a particular concentration for a specific period and the reductional type of separation in the nuclei of meristematic cells.

3. The above two effects have been suggested to be brought about through a change in the nucleo-protein balance of the cells. The possible role of amide in bringing about this process and relevant literature in this connection have been discussed.

71. Karyotypic difference in varieties of Lathyrus Odoratus.

ARUN KUMAR SHARMA and PRAFULLA CHANDRA DATTA, Calcutta.

In order to find out how far karyotypic changes or undetectable gene mutations have been associated with the origin of different varieties of *Lathyrus odoratus*, which differ in flower, colour, leaf nature, tendril character etc., a thorough analysis of the karyotype of the different pure varieties of *odoratus* have been carried out in this investigation. For the purpose, a new improved method involving pretreatment with paradichlorobenzen was employed and the procedure for all the strains had been kept constant.

It has been revealed, that in spite of a homogeneity amongst all the strains, each strain is characterised by its own karyotype. They mainly differ with respect to the number and position of constriction region in chromosomes. All these facts suggest that the structural changes of chromosomes have always been associated with the evolution of different varieties.

Regular meiosis noticed in these strains can be explained by assuming that through extensive cultivation and selection all the structural alterations have attained a state of homozygosity.

72. Chromosome studies in several members of Euphorbiaceae with a view to find out interrelationships.

ARUN KUMAR SHARMA and Miss MIRA JASH, Calcutta.

1. A cytological study of the chromosomes of nineteen different species of the family Euphorbiaceae under eleven genera has been carried out. The chromosomes numbers recorded are listed as follows :

1.	*Euphorbia nerifolia* Linn.	(2n=60)
2.	*Euphorbia tirucelli* L.	(2n=20)
3.	*Euphorbia bojeri* Hook.	(2n=40)
4.	*Euphorbia pilulifera* L.	(2n=18)
5.	*Euphorbia pulcherrima* Willd.	(2n=28)
6.	*Euphorbia heterophylla* L.	(2n=56)
7.	*Acalypha indica* L.	(2n=18)
8.	*Croton bonplandiaram* Morang.	(2n=20)
9.	*Codiaeum variegatum* L.	(2n=90)
10.	*Manihot utilissima* Pohl.	(2n=34)
11.	*Manihot glaziovii* Mall. Arg.	(2n=34)
12.	*Pedilcnthus tithymaloids* Poit.	(2n=36)
12.	*Synadenium grantii* Hook.	(2n=34)
14.	*Jatropa gossipifolia* Linn.	(2n=20)
15.	*Jatropa hastata* Jacq.	(2n=20)
16.	*Excoecaria bicolor* Hassk. Retzia.	(2n=22)
17.	*Putranjiva Roxburghii* Wall. Tent.	(2n=38)
18.	*Phyllanthus niruri* Linn.	(2n=28)
19.	*Phyllanthus reticulatus Poir. Encyc.*	(2n=28)

2. The previous literature on the family in the light of the present records has been discussed. In the family Euphorbiaceae marked role of polyploidy in the origin of species has been demonstrated.

3. Different lines of evolution as indicated through structure and behaviour of chromosomes have been delineated.

The evolutionary tendencies within different genera have been discussed first, followed by a discussion on the inter-relationship between different genera. The cytological study reveals in the genus *Euphorbia* alone at least five distinct lines of evolution within its species.

4. The significance of alteration of chromosome complements in the somatic tissue of an individual which has been found to be a characteristic feature of most of the species has been discussed in relation to speciation.

5. Various other peculiarities in the chromosome behaviour of the genera investigated have also been brought out—non-homologous chromosomes have been observed in *Putranjiva Roxburghii* (in seedling) and *Pedilanthus tithymaloids.*

73. Cytotaxonomic position of Crotalaria Brownei Bert. ex DC.

M. G. SRIVASTAVA, Calcutta.

Crotalaria Brownei Bert. ex DC. has been merged with *C. saltiana* Andr. Bot. Rep. by the taxonomists on the basis of morphology of the plants.

In the course of certain investigations on the cytogenetics and cytotaxonomy of Indian species of *Crotalaria,* it was discovered that although the 2n chromosome number is 16 in both the species, their karyotypes differ from each other in the morphology of chromosomes, position of the centromere, the size of the duplicated pair of chromosomes and the total length of the haploid complements.

The long chromosome A is satellited in both the species, but the second pair of SAT-chromosomes is different in the two; being the pair C in *C. saltiana* and the much smaller pair E in *C. Brownei.*

There is a pair of duplicated chromosomes in both the species. But while in *C. saltiana* it is E, in *C. Brownei* it is G.

The total length of the haploid complement in this species is 26·1μ as against 25·6μ of *C. saltiana.*

Lastly the number of the medianly and sub-medianly constricted chromosomes varies in the two species : whereas this ratio is 4 :4 in *C. Brownei,* it is 2 :6 in the other.

Thus it has been shown that the karyotypes of the two species bear no similarity. It has been suggested that the status of *C. Brownei* as a separate species be retained.

On the evidence of the points raised above, it has been suggested that *C. Brownei* is a relatively primitive species. This view has been discussed in the light of the relevant literature.

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74. Effects of some hormonal herbicides on the meiosis of plants.

M. G. SRIVASTAVA, Calcutta.

The effect of injecting different concentrations (250, 500 and 750 p.p.m.) of amide and butyl ester of 2, 4-D, M.C.P.A. and 3, 4, 5-T on the meiosis of *Crotalaria juncea* L. has been investigated. The injection was given at the base of the inflorescence axis and meiosis was studied from the buds collected 24 hours after treatment.

The effects of various chemicals have been compared, on the basis of anaphasic abnormalities and the data have been presented in the form of a Table. It has been concluded that with regard to *C. juncea* the effect of M.C P.A. is highest, followed by ester of 2, 4-D, amide of 2, 4-D and 2, 4, 5-T respectively.

Similarly, the relation of the different concentrations of the same chemical has been studied. It has been surmised that irrespective of the efficacy of the different chemicals on this plant, the frequency of aberration is directly proportional to the concentration of the chemical.

Various types of meiotic abnormalities like stickiness of the bivalents, bridges, fragments, laggards, extrusions and spindle aberrations recorded in the course of the present observation have been discussed and their occurrence explained. A very rare case of an anaphase I bridge persisting at anaphase II has been recorded. The possible causes for this persistence have been discussed.

Lastly, considering the effect of meiotic abnormalities on the pollen sterility and seed setting, it has been suggested that this aspect could be utilised in reducing the multiplication of weeds.

The possibility of the effect of these chemicals on the nucleic acid metabolism of chromosomes has been pointed out.

75. Meiosis in the artificially-induced tetraploid Iberis amara L.

S. L. TANDON and P. N. BALI, Delhi.

Meiosis was studied in 15 of the colchicine-induced tetraploid plants of *Iberis amara* L. Most of the possible configurations ranging from 7 quadrivalents to 14 bivalents at diakinesis and metaphase I were seen in the tetraploid. Although the majority of the pollen mother cells showed 14+14 distribution of chromosomes at anaphase I, a few of the pollen mother cells showed 12+16 or 13+15 distribution. Unlike the diploid, the presence of anaphasic bridges was not noticed in any of the cells. At metaphase II, 14 chromosomes in each nucleus were noticed. The anaphase II was also regular in most of the cells, with 14 chromosomes going to each of the four poles. Like the diploid, the number of microspores per pollen mother cell was 4 (normal tetrads) in the tetraploid.

76. Studies on inducing polyploid flower plants and their utilization. II. Linaria vulgaris.

S. L. TANDON and P. N. BALI, Delhi.

This paper is concerned with the work done on colchicine-induced polyploidy in *Linaria maroccana Hook f.* Treatments given to growing points of young seedlings with 0·10 and 020 per cent aqueous solution of colchicine for 6 hours gave best results from the point of view of survival of seedlings and induction of polyploidy. The stomata and pollen grains of the tetraploid were bigger than those of the diploid. The number of stomata per unit area in the tetraploid was, however, less than that of the diploid. The percentage of pollen fertility in 4n plants was rather low. The fruit, as well as the seed setting in tetraploids was also poor. The seeds of tetraploids were larger than those collected from control plants.

The chromosome numbers of the diploid and tetraploid were determined as $n=6$ and $n=12$ respectively. The diploids showed 6 bivalents at diakinesis. The distribution of chromosomes at anaphase I was quite regular, 6 chromosomes being clearly visible at either pole. The tetraploids showed 12 bivalents at diakinesis and metaphase I. Other configurations seen at diakinesis were $1^{IV}10^{II}$. $2^{IV}8^{II}$ and 6^{IV}. Majority of pollen mother cells showed 12+12 distribution of chromosomes at anaphase I. In some pollen mother cells, 1 chromosome was seen to lag behind and this resulted in the unequal distribution of chromosomes at the two poles.

The colchincine-induced tetraploid as characterised by the presence of large conspicuous flowers. Tetraploidy had also prolonged the period of flowering. The induced tetraploid *Linaria maroccana Hook f* has thus been found to be superior to its diploid progenitor with regard to the above mentioned characters. Reduction in the number of seeds per fruit was, however, noticed in the tetraploids but this handicap could be overcome by leaving a larger number of plants for seed collection.

77. Cytology Genetic System and Life History of Bellendena Montana R. Br.

C. VENKATA RAO, Waltair.

The cytology, genetic system, floral anatomy and embryology of *Bellendena montana* R. Br., a monotypic endemic of Tasmania belonging to the Proteaceae, are studied.

The haploid chromosome number is 5 and the diploid 10. These are the smallest numbers yet reported in the family and 5 seems to be one of the two basic numbers in the family, the other being x-7 (of *Persoonia*).

Bellendena shows a gynodioecious system of sex distribution; the percentage of female plants in populations on Mt. Wellington and Mt. Field National Park ranges from 35 to 48. The two kinds of plants and their flowers are morphologically indistinguishable.

The flowers are actinomorphic, devoid of nectaries and the floral organs and their traces do not show any adnation or connation. The carpel is 3-traced.

The anther wall is 6-layered. The hypodermal layer functions as the fibrous endothecium in pollen fertile flowers and the innermost as the tapetum which is of the secretory type. There is a secondary increase in the sporogenous tissue of the anther loculus. Cytokinesis is of the simultaneous type and is brought about by furrowing. The pollen grains are triangular, triporate and smooth walled, and two celled at the time of shedding. The anther loculi of the pollen sterile flowers are empty and do not dehisce.

The ovary shows two orthotropous pendulous ovules which are bitegmic and crassinucellate. The micropyle is formed only by the inner integument. The embryo sac develops according to the *normal*-type. The synergids are hooked and show filiform apparatus. The polar nuclei do not fuse before fertilization and the three antipodals are inconspicuous. A postament is formed during the course of seed development. The endosperm is of the nuclear type; large polyploid nuclei formed due to nuclear fusions are noticed in the antipodal end of the embryo sac. The fruit is a dry, light, 1-seeded nut with a membranous pericarp. The seeds are endospermic and wingless.

The embryo develops according to the *Penaca*-variation of the Asterad type.

Bellendena montana shows a large number of primitive morphological, cytological and embryological characters which point to its being a palaeo-endemic.

This work was carried out during the tenure of a Colombo Plan Fellowship, in the Botany Department of the Tasmanian University.

PLANT PHYSIOLOGY

78. Physiological studies on salt-tolerance in wheat and gram. II. Influence of chloride and Carbonate of sodium on seedling respiration.

S. N. BHARDWAJ and I. M. RAO, Agra.

The influence of a harmful dose of NaCl (0·6% solution) and of Na_2CO_3 (0·2% solution) on seedling respiration (up to 4 days after sowing) in two varieties of wheat (N.P. 165 and C 591) and of gram (N.P. 28 and T. 87), as indicated by the oxygen uptake following Warburg's technique, has been investigated. Seedlings were grown on moist filter-paper at constant temperature (22°C) and the respiration rate was noted at the same temperature at intervals of 24, 36, 48, 54, 60, 72, 78, 84 and 96 hours after sowings. The control sets received throughout a supply of distilled water and the treated ones the respective solutions. The following conclusions were noted :

(a) Wheat seedlings, during the period of study (0-96 hours), exhibited a higher respiration rate than those of gram and varietal differences were also evident, particularly in wheat.

(b) A continuous supply of 0·6% NaCl solution to the growing seedlings affected respiration rate of wheat and gram. The depressing influence became evident from 36 hours onward in wheat ,while it was so in gram from the beginning; however, a tendency for recovery in the rate of respiration of both wheat and gram was evident on the third day. Depression of the respiration rate was initially greater in gram than in wheat. The varieties of wheat and also of gram indicated differences; with the salt supply, respiration rate of var. C. 591 was depressed more compared to the var. N.P. 165, while in the gram depression in var. T. 87 was apparently greater than in the var. N.P. 28.

(c) Wheat and gram responded differentially to the influence of supplying 0·2% Na_2CO_3 solution to the growing seedlings. Stimulation of respiration rate in wheat was noted upto 48 hours and from 72 hours onwards the rate was depressed, while in gram no clear stimulation was seen, although a tendency for depression followed slight recovery was apparent. Wheat varieties indicated almost no differences but in gram, var. T. 87 alone showed slight depression.

The difference between wheat and gram regarding the influence of NaCl solution on their respiratory activity was not marked but gram was more adversely affected than wheat by Na_2CO_3 solution. However, with the two salts varietal differences in the two crops were more evident.

79. Effect of Certain Auxins and Their Antagonists on the Process of Vernalization in *Lens esculanta* Moench.

S. C. CHAKRAVARTI, Bhopal.

Present investigation has been undertaken to determine the effect of prechilling soaking treatment of seeds of *Lens esculanta* Moench, strain "Ample", with 500, 50, 5, 0·05 and 0·005 ppm. aqueous solution of IAA, IBA, NAA, 2, 4-D and TIBA, 0·5, for a period of 8 hours. Soaking in almost all concentrations of the five chemicals brought about significant inhibition of flowering induced by vernalization. Minimum effect was produced in plants raised from seeds treated with IAA and the maximum in those with TIBA and 2, 4-D.

Possible mechanism by which TIBA, an anti-auxin acts in a way similar to that of auxins like IAA, IBA, NAA and 2, 4-D is discussed.

80. Effect of Gibberellic acid on the induction of Early Flowering in *Sesamum indicum* L.

S. C. CHAKRAVARTI and N. J. ABRAHAM, Bhopal.

Treatment of plants with gibberellic acid (GA) has invariably resulted in their extension growth. In biennial species, where the first phase of growth is confined to the formation of a rosette of leaves and the second of stem elongation and flowering, GA treatment has resulted in an early termination of the vegetative cycle. As in these plants onset of the reproductive phase and stem elongation go hand in hand, the effect of GA in bringing about an earliness in flowering might be an indirect one i.e. by the way of causing an elongation of the stem. In order to test the above possibility, effect of pre-sowing soaking treatment of seeds and of foliar spraying to runoff with aqueous solutions of GA on the flowering of the plants of *Sesamum indicum* L., T. 10, which has a single phase of growth, was determined. Concentrations of the chemical used were 1, 10, and 100 ppm.

In all the treatments there was a significant increase in the height of the plants but no significant earliness in flowering. In plants receiving five treatments with 100 ppm. of GA as weekly foliar sprays commencing at an age of six days and in plants receiving treatments for five consecutive days and also five times once in every three days commencing at an age of twenty days, there was a significant delay in the average time taken for the opening of the first flowers on the individual plants. Further studies with plants having a single phase of growth are in progress.

Samples of gibberellic acid used in these experiments were obtained through the kind courtsey of Eli Lilly and Company, Indianapolis, Ind., U. S. A.

81. Experimental Induction of Leaf Heteromorphism in Sesamum indicum L.

S. C. CHAKRAVARTI and B. K. ARORA, Bhopal.

In the normal plants of *Sesamum indicum* L., strain T. 10, the lower leaves are ovate. Through a number of transitory forms they become lanceolate in the flowering region. If the cotyledons are removed soon after germination, the first pair of leaves develop a prominent concavity on both the sides. This concavity is nearer the apex than the base. Removal of one cotyledon, however, is without any effect.

First leaves developed after the decapitation of the shoot apices are oblong. Subsequent leaves, however, gradually change to the normal type through a number of intermediate forms. Subjection of seedlings of several members of the families Leguminoseae, Cucurbitaceae and Euphorbiaceae failed to bring about a change in the outline of the lamina.

82. Effect of a-naphthaleneacetic Acid and 2, 3, 5-triiodobenzoic Acid on the Flowering of Sesamum indicum L.

S. C. CHAKRAVARTI and B. K. ARORA, Bhopal.

Effect of foliar sprayings with 500, 100 and 1 ppm. aqueous solutions of NAA, an auxin and TIBA, an anti-auxin, on the flowering of *Sesamum indicum* L., T. 10 has been studied. With the exception of plants treated every third day and once a week with 500 and 100 ppm. of NAA, where there was a significant delay in the process, rest of the treatments were without any effect. Failure of TIBA to induce early flowering while there is an inhibitory effect of NAA, suggests that the applicability of the theory of "auxin anti-auxin" ratio, put forth by certain workers to explain the mechanism of flowering in general, is open to question.

83. Response of an early-winter rice to short photoperiod.

T. R. DUTTA, Agartala and G. MISRA, Cuttack.

The effects of 8-hour (8 a.m. to 4 p.m.) short photoperiods have been studied in T. 442 (a selection from Kalakartika of Orissa), an early-winter variety of rice, in pot culture experiments. Of the six experimental sets, one was kept as control under the natural day length and the rest five were subjected to short-day treatment one after another at different ages of 10, 20, 30, 40 and 50 days respectively for a period of one month in each set, after which the treated plants were grown in the open space along with the controls till the time of harvest. There was conspicuous earliness in flowering in all the short-day treated plants in comparison with the control. The degree of earliness was maximum in the case when the treatment was given to youngest seedlings and gradually decreased with the shifting of the commencement of the treatment to seedlings older and older in age. Plants treated with short days in general were taller than the controls and also possessed larger leaves. The grain yield, however, was very low in the plants in all the treated sets presumably because they were forced to flowering early and thus had a considerable curtailment of the vegetative growth period.

84. On the hypogeal and epigeal germination of the seeds in the family Leguminosae.

S. KALYANASUNDARAM, Annamalainagar.

This study comprises of 200 species spread over 58 genera of the Leguminosae. Intensive observations have been made on the germinating seeds in respect of the hypogeal and epigeal nature of their germination. The distribution of these two types of germination through the Leguminosae is of interest. The sub-family Papilionaceae shows both hypogeal and epigeal types of germination. In Caesalpinieae the epigeal type predominates and hypogeal germination occurs only in few species. In Mimosae the germination is strictly epigeal. The greater frequency of hypogeal germination in Papilionaceae as compared to Caesalpinieae and the total absence of hypogeal germination in Mimoseae suggest that the hypogeal condition may have been the ancestral type of germination of Leguminosae and that the epigeal condition has been derived from the hypogeal ancestors.

The present study lends further support to my view namely that the Papilionaceae is the most primitive in its vegetative ontogenetic evolution and Mimosae the most advanced, Caesalpinieae occupying a mid-position (*Indian Sci. Con. Ass.*, 1955, p. 227).

85. 2,3,5-Triphenyl Tetrazolium Chloride method for predicating viability of stored legume seeds.

R. N. NUGGEHALLI and S. K. MAJUMDER, Mysore.

Triphenyl tetrazolium reduction method was employed for testing viability of stored seeds of pulses. It was observed that the metabolically active tissues of the cotyledons of the legume seeds reduced 2, 3, 5-triphenyl tetrazolium chloride to coloured triphenyl formazan unlike the endosperms of seeds of cereals. Difficulty was encountered in differentiating the germ portion from the rest of the seed due to the above phenomenon. This was conspicuous for *Dolichos lablab* seeds. Presoaking period for *Phaseolus mungo, Cicer arietinum* and *Dolichos lablab* were standardized and found to be 4, 6 and 16 hours respectively. The technique standardized for *Dolichos lablab* seeds are reported to be as follows: Presoaking for 16 hours in distilled water and soaking in acidified tetrazolium chloride (2 drops 20% acetic acid in 5 ml. 0·5% aqeuous solution) for 3 hours induced optimum differential staining in embryos and cotyledons. The prediction by this method for viability compared favourably with usual germination tests of *Dolichos lablab* seeds.

86. Effect of Hydrogen Ion Concentration on Stem-gall of Coriandrum Sativum L.

S. B. MATHUR, Agra.

This paper deals with the effect of Hydrogen ion concentration on the disease intensity of Stem-gall of coriander. The plants were grown in sand culture supplied with modified Shive nutrient solution and the pH levels were adjusted by adding N/10 NaOH and N/10 Hcl as buffers. In all six pH levels (4·6, 5·6, 6·6, 7·4, 8·4 and 9·2) were maintained and the disease intensity on plants was assessed following the technique of Gupta (1954).

The results indicate that the disease develops both in the acidic and alkaline conditions indicating little pronounced influence of pH on the disease. However, Soil pH levels from 5·6 to 7·4 seem to be most suitable for disease expression, while the opposite extremes of the pH viz., 4·6 and 9·2 retard the disease development to a considerable extent. It may be further added that the disease intensity recorded was not very high, maximum disease intensity being about 15% at pH 7·4. The disease thus cannot be placed in a definite category being favoured by acidic or alkaline soil conditions, but at the same time the pH seems to have some influence on the intensity of development of the disease.

87. Effect of some plant growth substances on an early-winter variety of rice.

G. MISRA and G. SAHU, Cuttack.

The effect of three plant growth substances IAA, NAA and TIBA at the concentrations of 1000, 500, 250 and 100 parts per million upon the growth and reproduction of an early-winter variety of rice has been studied. The treatment consisted of pre-sowing seed soaking for 72 hours followed by post-sowing weekly foliar spray commencing from the 4th week of sowing till ear emergence. IAA had no effect on the time of ear emergence, vegetative growth as well as the grain yield. NAA brought about a delay in ear emergence and an inhibition of vegetative characters more conspicuously in the early stages, but was without any effect on the grain yield. TIBA was without any effect on the flowering time and grain yield, but showed a poor vegetative growth.

88. Effect of some plant growth substances on a late-winter variety of rice.

G. MISRA and G. SAHU, Cuttack.

The effect of three plant growth substances IAA, NAA and TIBA at the concentrations of 1000, 500, 250 and 100 parts per million (ppm) upon the growth and reproduction of a late-winter variety of rice has been studied. The treatment consisted of a preliminary seed soaking for 72 hours followed by weekly foliar spray starting with 4-week-old seedlings till the time of ear emergence. IAA brought about a significant earliness in flowering time of the plants at the concentrations of 500, 250 and 100 ppm, but had no effect on vegetative growth characters and grain yield. NAA brought about a significant earliness at all the concentrations and an inhibition of vegetative characters at the earlier stages, but showed a significant increase in height of the plants at the mature stage. It had no effect on the grain yield. TIBA brought about a significant earliness in all the concentrations, produced more tillers and leaves throughout the vegetative phase and a significant increase in the grain yield. Thus the plant growth substances produced quite different results in the late-winter variety compared to the early-winter variety.

89. On the effect of sound evoking change in the histology of certain water plants.

V. NAINAN, Annamalainagar.

Young healthy shoots of submerged water plants, *Hydrilla verticillata* and *Cabamba* sp., were subjected to the excitation of tuning-fork with a frequency of 340 per second by dipping its tail-end in water both morning and evening for five minutes each for a total period of 30 days. Proper controls were maintained.

As a result it has been found that in both the species, the experimental shoots and leaf area in general had increased appreciably as compared to the control. Besides, interesting histological changes have been evoked in the wake of excitation of sound. They have been found practically of the same order in both the species : as for example, in the experimental plants the size of cells had grown 50% bigger, cell-wall was 40% thinner, and nuclei & chloroplasts were bigger to the extent of 25% as compared to those of the control plants. It was curious to note that in both the species the colour of the cytoplasm had been rendered violet as compared to the control which was colourless.

In the case of sound excited plants of *Hydrilla verticillata* the streaming movement of protoplasm was found to be much faster than that of the control. This is in confirmation of the observations of Singh and Stella Ponniah (*Proc. Indian Sci. Cong., Lucknow*, 1953, pp. 119-120).

90. Effect of 2, 4-D, IAA & NAA on the Germination of spores of certain Fungi.

P. N. NARULA & S. B. MATHUR, Agra.

Conidia of *Alternaria solani, Aspergillus* sp. (black) and chlamydospores of *Protomyces macrosporus* Ung., were germinated in 2, 4-D, IAA and NAA in concentrations ranging from 1 ppm to 500 ppm and curiously enough inhibition of germination was obtained even in the lower concentration of hormones. There is a tendency for greater inhibition as the concentration of the hormone is increased till complete inhibition occurs in higher concentration of the hormones.

There is hardly much difference in the general behaviour of *Aspergillus sp.* (*black*) and *Alternaria solani* towards the three hormones, effective inhibition taking place only in higher concentrations of hormones. In respect of *Protomyces macrosporus* NAA appears to be more effective than 2, 4-D, complete inhibition being obtained in 50 ppm of NAA and 200 ppm of 2, 4-D.

91 Control of some weeds by 2, 4-dichlorophenoxyacetic acid.

B. PANIGRAHI, Berhampur and G. MISRA, Cuttack.

Two common weeds of Orissa, *Sphæranthus indicus* L. and *Calotropis gigantea Br* were sprayed with an aqueous solution of the sodium salt of the plant regulator 2, 4-dichlorophenoxyacetic acid (2, 4-D) at five concentrations 1·0%, 0·5%, 0·25% and 0·05%. The two weeds were very susceptible to the chemical, *Sphæranthus* being a little more than *Calotropis*. The immediate effect of the weedicide was an arrest of growth. The tender shoot apices bent down. The leaves, young and old, folded along their margins in the form of boat-shaped structures. Leaves turned yellow and began to dry up starting from the tip and margin regions and gradually spreading over the entire leaf surface. This was followed with the shedding of the leaves and drying of the branches culminating ultimately in the death of the plants within about a fortnight after the spray of the chemical. Out of the five concentrations tried the three higher concentrations proved more effective than the others.

92. Factorial Photoperiodism in Relation to Short day and Long day plants.

S. PANNIRSELVAM, Annamalainagar.

It has recently been shown (S. Pannirselvam : Pro. Indian Sci. Cong., 1955 and 1956) that earliness and lateness in flowering can be brought about by varying the quantum of artificial, morning (6 A.M. to 12 Noon) and evening (12 Noon to 6 P.M.) lights. It is known as 'Photoperiodism in relation to factorial lights.' In the present investigation three short day plants, *Cosmos bipinnatus*, Cav., *Tagetes crecta* Linn. and *Impatiens balsamina* Linn. and three long day plants, *Petunia hybrida* Hort., *Coreopsis tinctoria* Nutt, and *Phlox drummondii* Hook., were experimented under the scheme of factorial photoperiodism to see as to how the short day and long day plants behave. All the three short day plants flowered earliest under the factoria light 2A+4M+6E and all the three long day plants flowered earliest under the factorial light 4A+6M+2E. It is proposed to call 2A+4M+6E as a short day factor and 4A+6M+2E as a long day factor.

93. The effect of pH and certain metabolic inhibitors on the Absorption and Translocation of Phosphorus (P^{32}) in seedlings of higher plants.

S. K. ROY & (MISS) MADHURI DUTTA, Calcutta.

The use of P^{32} has provided the plant physiologists with a new tool in the study of absorption and translocation of phosphorus in plants under various conditions. The present communication refers to some such studies in which the rate of absorption of P^{32} through the roots of mung and oat seedlings and its subsequent transport into various parts as influenced by metabolic inhibitors like Fluoride, iodoacetamide and fluoroacetate and germination inhibitor like parasorbic acid, have been made. Fluoride and iodoacetate appear to inhibit the rate of absorption of P^{32} but not to affect significantly the subsequent translocation. Fluoroacetate in addition to inhibiting the absorption also appears to inhibit the translocation.

The growth regulator NAA is found to inhibit the root absorption of P^{32} in oats. This inhibition is abolished by parasorbic acid in low concentration.

pH of the nutrient solution within a limited region do not affect significantly the rate of absorption of P^{32} by the roots but the translocation is significantly influenced, lower pH favouring the latter. The pH effect is independent of the age of the plant or the light condition of growth or experiment. It appears to lend support to the postulated formation of an "site-ion complex" the subsequent dissociation of which determines the rate of translocation.

The role of active processes in anion absorption is discussed.

94. Studies in the physiology of fruits and vegetables. V. Analytical Observations in two varieties of banana during storage and ripening in different temperatures.

SHYAMA PADA SAHA and J. K. CHOUDHURY, Calcutta.

Green mature fruits of two varieties of banana, viz., Champa and Martaman, were stored separately in 36°-38°F and 60°-62°F with R. H. 80--85% and in room temperature (80°-120°F). In addition, Champa was also kept in 50°-52°F (R. H. 80-85%). They were kept in these temperatures to study their storage requirements and some of the metabolic changes that take place during ripening.

The fruits in room temperature became 'over-ripe' in 6 to 7 days, but they could be stored for 28 and 41 days, respectively, in 60°-62°F and 50°-52°F in market-able condition. 36°-38°F was found to be absolutely useless for storage purposes due to extreme chilling effects.

During storage, loss in weight of these fruits was accompanied by a slight increase in the water content of the pulp and a significant decrease in that of the peel.

Alcohol soluble matter, sugars, titratable acid and fat increased during ripening, sometimes with a decrease when the fruits over-ripened, whereas alcohol insoluble matter and pH decreased during ripening. Vitamin-C content was maximum when the fruits were green and fully mature but decreased steadily during ripening.

From the observations on the metabolic changes and rate of respiration in air at 30°C, it was clear that such changes were most pronounced when the fruits changed from green to yellow in colour.

95. Factors concerned in the secondary growth in the petioles of herbaceous dicot leaves.

B. SAMANTARAI and T. KABI, Cuttack.

Secondary growth is induced in the petioles of isolated herbaceous dicot leaves by the application of synthetic hormones like β-indolyl butyric acid (I B.A.) although in the attached leaves of such plants secondary growth does not take place normally. Slight secondary growth is also seen in the isolated controls. Food material like sugars, asparagine and also 'B' vitamins do not seem effective in inducing or promoting secondary growth. Maleic Hydrazide (MH) however at a concentration of 100 p.p.m. (parts per million) when administered on alternate days stops secondary growth completely even if the leaf is treated with I.B.A. In case of the attached leaves when translocation is prevented by ringing the stem just above and below the nodes secondary growth is seen in the leaves. When such leaves are treated with I.B.A. through their cut tips copious secondary growth is observed. Again, by feeding the attached leaves with 'B' vitamins, sugar and asparagine this secondary growth do not seem to be enhanced appreciably. When MH is administered separately or along with sugars, asparagine and 'B' vitamins secondary growth is completely checked It is suggested that the secondary growth is induced by either native auxin or applied hormone, which in presence of MH an auxin antagoniser is rendered ineffective. In the attached leaves lack of secondary growth is due to translocation of auxins away to the stem.

96. Effect of β-indolyl butyric acid on the water relations of the isolated leaves of Ipomoea batatas.

B. Samantarai and T. KABI, Cuttack.

The effect of β-indolyl butyric acid (I.B.A.) on the rate of absorption, transpiration, and water retaining capacity of the isolated leaves of *Ipomoea batatas*, was studied. It was found that the leaves treated with 2·5 ppm. of I.B.A. absorbed and transpired more water than the control leaves, after the treatment with hormone. The rate of absorption and transpiration increased steadily till the emergence of roots in the treated leaves, but the rate of absorption was more than the rate of transpiration. In the control leaves also slight increase in these processes was observed. The fresh weight of the treated leaves was found to increase in comparison with the control. The treated leaves showed a great capacity for retaining water, than the control leaves. It is suggested that due to the application of synthetic hormone hydrolysis of carbohydrates and nitrogenous material takes place and the hydrolytic products were translocated to the petioles, thus an increase in the osmotic pressure of the sap of the petiole is possible. Due to the increased osmotic concentration the rate of absorption became more. As the turgidity increased due to greater absorption transpiration also increased.

97. Effect of MH on the rooting response of some stem cuttings of Argyreia speciosa Sweet.

B. SAMANTARAI and H. PATTNAIK, Cuttack.

Stem cuttings of *Argyreia speciosa* were treated with aqueous solutions of β-indolyl butyric acid (I.B.A.) and Maleic Hydrazide (MH). The concentration of I.B.A. was 100 ppm. (parts per million) as it was found to be the optimal concentration for rooting response of this twig. The concentration of MH applied were 100, 50 and 20 ppm. Controls were kept in water. The treatments lasted for 24 hours and subsequently washed and cultured in tap water under humid conditions in diffused light. The twigs after being treated with I.B.A. were treated with MH once or at regular intervals. Along with these treatments in certain cases the twigs were treated with a mixture of aneurin hydrochloride and Nicotinic acid. It was found that the cuttings treated with I.B.A. produced copious roots where as those treated with MH had no roots at all. However cuttings which were previously treated with I.B.A. and subsequently with MH produced some roots at lower concentrations of MH. As MH is an auxin inhibitor it stops rooting in these cuttings. At low concentrations MH is probably not able to inhibit the action of the native auxin which is supplied from the leaf afterwards, therefore some rooting is observed.

98. Correlation of the vascular pattern to different aspects of Growth in the roots of isolated leaves.

B. SAMANTARAI and S. K. SINHA, Cuttack.

Roots were induced in the isolated leaves of *Ipomoea batatas* Lamk., *Impatiens balsamina* L. and *Basella alba* L. by the application of 10 parts per million (10 ppm.) of β-indolyl butyric acid (I B.A.) in aqueous solutions. The various aspects of growth of these roots viz., average length of roots, average number of branches per root, average length of these branches, average fresh weight and dry weights in relation to the various vascular patterns of roots were examined. It is seen that all these aspects of growth increase along with the increase in the number of vascular strands in roots. It is suggested that this correlation of the growth aspects to the vascular pattern is dependent on the auxin content and food factor.

99. Physiological studies on salt-tolerance in crop plants. III. Influence of sodium sulphate on seedling respiration in wheat and gram.

M. N. SARIN and I. M. RAO, Agra.

The depressing influence of sodium sulphate on early seedling growth of wheat and gram (upto 4 days after sowing) has been investigated by the authors in earlier studies. As growth depends on metabolic activities, an attempt has been made in the present study to investigate the influence of a 'depressing' concentration of the salt on respiration of wheat and gram seedlings and to seek its possible correlation with the depressed growth.

The seeds were allowed to grow on moist filter-paper in petri-dishes in a humid dark chamber upto 96 hours. The 'control' and the 'treated' sets received distilled water and 0·6 per cent sodium sulphate solution respectively. The respiratory activity, expressed as amount of oxygen utilized by one mgm. dry weight of seedling in one hour (QO_2), was studied upto 96 hours at 12 hour intervals, using warburg's respiration apparatus. Uniform seedlings were kept in contact with the test-solution in the respiratory flask and the respiratory activity was recorded at 28°C. 'Fresh' and 'dry' weights of the seedlings were also determined at each period.

The respiratory activity increased with the age of the seedlings, but there appeared for wheat three different phases in the rising curve for rate of respiration. The first phase, ending at 60 hours, indicated a fairly steady rise, while the second (between 60-72 hours) showed an abrupt rise which slowed down during the third phase (72-96 hours). The rate of respiration of wheat was at a higher level than of gram from the beginning but the gap between the two widened with the age of the seedlings.

Sodium sulphate depressed the respiratory activity of both the crop plants. In wheat, the effect was not marked upto 36 hours after sowing, but became evident between 48 and 60 hours; the maximum depression (60%) was reached at 60 hours. In gram, however, the depression started earlier i.e. at 36 hours but, as in wheat, the maximum inhibition (67%) was observed at 60 hours. Further, at all ages of the seedlings, gram was more adversely affected than wheat.

The other characters, dry-weight, fresh-weight, and moisture percentage on 'fresh' and on 'dry' basis of the seedlings, have been correlated with respiration and the possibility of a direct relation between the moisture content of the seedlings and their respiratory activity has been discussed.

100. Growth promoting effects of Gibberellic Acid in Tagetes patula under tropical conditions.

S. SARKAR, Calcutta.

Three-week old seedlings of *Tagetes patula* grown in pots on manured garden soil were treated with 10^{-4} and 10^{-5} Molar Gibberellic acid in 2 per cent alcohol solutions. To facilitate penetration into the tissues 0·01% Lissapol, a non-ionic detergent was added to each solution. The plants treated with Gibberellic acid were significantly taller than the controls, the maximum length attained by a single internode was also higher in the treated groups, but there was no true etiolation. There was no effect on the abscission of the cotyledon and no epinasty of leaves. 10^{-4} Molar GA seems to be hardly more effective than 10^{-5} Molar in causing elongation. Some other factor is apparently limiting the process in the former case. The possibility of an interaction with auxin in promoting growth in length is indicated.

101. Tracer Studies on the Biochemical Aspects of flowering. III. Further observations on the Low Intensity Light Process of Photoperiodism.

S. P. SEN, Calcutta.

In a previous communication (Sen, S. P. Proc. 44th. Ind. Sci. Congr., Part III, p. 280) it was observed that one of the effects of red light in the low intensity light process of photoperiodism on the products of dark or photosynthetic fixation of $C^{14}O_2$ is a marked change in the radio activity of malic acid. In the long day Wintex barley it increases, in the short day *Xanthium* or Biloxi Soy-bean it decreases. Wavelengths of the near infrared region reverse this effect. It has now been observed that the malic acid formed in the photosynthetic fixation of $C^{14}O_2$ in red light during the dark interruption treatment also behaves in the same way.

α-Naphthalene acetic acid, however, does not substitute for the red light treatment in so far as its effect on malic acid is concerned, opposite results being obtained. When the auxin and red light are allowed to act together they seem to act in an opposite manner. The resultant difference in the two effects is more marked in Soybean than in barley.

Marked changes were also observed in the products of $C^{14}O_2$ fixation in red light. In barley, where in normal photosynthesis in white light more than 80 per cent of the fixed carbon is detected in glucose and sucrose, the sugars formed in red light contained much less C^{14}-activity. Considerable activity was however detected in alanine, which completely disappeared during the near infra red treatment in natural air. In *Xanthium* succinic acid behaved in a similar way.

102. Tracer Studies on the Biochemical Aspects of flowering. IV. Translocation of products from induced leaves.

S. P. SEN, Calcutta.

It is generally believed that during the period of photoperiodic induction some substance (S) is synthesised in the leaves which is translocated to the growing points where floral primordia are initiated. The translocation of the products of photosynthetic fixation of $C^{14}O_2$ out of the leaves of the short day Xanthium has been studied at periodic intervals during the inductive dark period and the light period which followed it. The rate of translocation was initially very slow, it more than doubled over the critical dark period and then slowed down again. The rate slowed further when the leaves were subjected to light for 6 hours. The leaves at this stage contained a large number of compounds not detected among the normal products of photosynthesis or in the dark period which follows the light period during induction treatment.

The translocation of tagged compounds to the growing points of intact plants have also been studied. Since CO_2 fixation is known to be essential during the dark period of induction treatment for *Xanthium*, $C^{14}O_2$ was supplied to intact plants during a 16 hours dark period with or without a dark interruption treatment with red light. Analysis of buds seven days later indicated no qualitative difference; marked quantitative changes were however observed in four compounds present in larger amounts in the induced plants. When the long day Wintex barley, which requires CO_2 during the light period for flowering is supplied $C^{14}O_2$ during the light period for 4¼ hours on the 3rd day of a 6 day induction period and the growing points analysed on the 10th day no quantitative difference was observed between C^{14}-labelled products found in the buds of induced and non-induced plants. C^{14}-activity in the induced plants were however much higher than in non-induced ones. The compounds detected are the usual cell metabolites e.g., sugars, organic acids, amino acids, etc.

103. Effect of different Carbon-di-oxide Environments on Acid Accumulation in Ananas Salina.

P. V. V. SESHAGIRI and P. NARASIMHAM, Waltair.

Data with respect to changes in titratable acidity and the components acids in leaves of *Ananas sativa* when cultured in different concentrations of CO_2—0, 1%, 5%, 10%, 15%, 25%, 50%, and 75%, are presented in this paper.

Culturing the leaves of *Ananas sativa* in moderately rich carbon-dioxide atmosphere increases acid accumulation in the leaves. With increasing CO_2 concentration there is observed an increase in acid content up to a concentration of 10%. At still higher concentrations of CO_2, acid accumulation is depressed. It is suggested that while at lower concentrations CO_2 is used as a metabolite for acid formation, at higher concentrations CO_2 becomes toxic to the leaves and at the highest concentration studied (75%) there is observed a steady decline in acidity.

104. Nitrogen Nutrition and Organic Acid Metabolism in Begonia Anamalayana, Bedd.

P. V. V. SESHAGIRI and B. G. SRINIVASARAO, Waltair.

Investigations were conducted on the influence of nitrogen feeding on the general growth, organic acid metabolism and respiration in *Begonia anamalayana* Bedd. Nitrogen was administered to the plants in the form of ammonium nitrogen (Ammonium sulphate) and nitrate nitrogen (Calcium nitrate) at three different levels and with and without basal dressings of potassium and phosphorus. Controls were also maintained. Also, the effect of exposure to light after prolonged culture in darkness on the acid content of leaves was recorded.

The data collected revealed that *Begonia anamalayana* Bedd. does not exhibit the typical 'Crassulacean' diurnal fluctuations in acidity. Ammonium nitrogen had a more profound effect on the general growth of plants. Though feeding nitrogen in both the forms brought about, in general, a marked increase in the titratable acids in leaves, this was more so in plants that received nitrate nitrogen. As the maximum T.A.N. values for any day increased, the minimal values also increased correspondingly and therefore no appreciable diurnal variations were observed. Evolution of respiratory CO_2 increased in the treated plants but plants treated with ammonium nitrogen and which had lesser acid content recorded higher rates of respiration. Both the controls and the treated plants exhibited dark acidification in the early periods of darkness, but immediately on transference to light after prolonged culture for 24 hours in the dark, the plants recorded higher acidity. This photo-acidification, a non-crassulacean feature, is explained as being probably due to the formation of Oxalic acid, an inert acid, that does not enter into the tricarboxylic acid cycle.

105. Studies in the effect of moon-light (Lunoperiodism) on the growth and and reproductive phase of plants—III.

T. C. N. SINGH, Annamalainagar.

There is no work on the effect of moon-light on the growth of plants except by the author himself (Singh, T. C. N. *Proc. Indian Sci. Cong.* 1955; *Ibid* 1956) who has experimented on *Bryophyllum calicynum* Salis., *Manihot utilissima* Pohl, *Althaea rosea* Cav., *Impatiens balsamina* Linn., *Saccharum officianarum* Linn., *Lycopersicum esculentum* Mill, *Zinnia elegans* Linn. and *Petunia hybrida* Linn.

In the present investigation experiments were repeated on *Bryophyllum calicynum* Salis, *Manihot utilissima* Pohl and *Saccharum officianarum* Linn., and the same were extended to ten strains of tobacco obtained from Central Tobacco Research Station, Rajamundry.

The results in respect of the first three species have been found to confirm fully, the previous observations, namely *Bryophyllum calicynum*, Salis. and *Manihot utilissima* Pohl., are positively responsive to moon-light and *Saccharum officianarum*, Linn., is negatively so, namelv its growth was found to be more vigorous in the absence of moon-light. The results in respect of Rajamundry tobaccos are equally interesting namely, all of them except Yellow Special (which succumbed to certain disease in the process of experimentation) are positively responsive to moon-light in respect of their vegetative and reproductive phases. But the greatest height percentage of over 60 was attained by Golden Wilt; and Golden Harvest; and the highest production of flower of the order of 90 per cent was scored by Bottom Special. The greatest earliness of 24 to 37 days was found in the case of Virginia Bright.

106. On the Effect of Sound produced by Tuning-Fork on the growth of certain plants.

T. C. N. SINGH and STELLA PONNIAH, Annamalainagar.

In the present investigation study has been made of the effect of sound produced by an electrically run tuning-fork on the growth and flowering of two ornamental plants, viz. *Cosmos bipinnatus* and *Angelonia grandiflora* and two economic plants viz. *Hibiscus esculentus* and *Sesamum indicum.* Results obtained herein demonstrate that even this sound has practically similar effect on the growth of plants as those produced vocally or from instruments like *violin, veena, sruti-box* etc. in our previous experiments. A brief summary of the results is appended below species-wise :

Cosmos bipinnatus : Growth performance in length of plants as well as in leafiness was 25 per cent superior and flowering was 3 weeks earlier in the experimental plants as compared to the control.

Angelonia grandiflora : Leafiness in experimental plants was over 100 per cent superior to the control plants, thereby initiating and ensuring superior growth in length of about 15 per cent and branching of about 30 per cent in the experimental plants as a whole. Earliness of flowering of 3 weeks was induced in experimental plants.

Hibiscus esculentus : Tostart with, excitation by sound in this species had depressent effect on the growth of experimental plants. But subsequently after a lapse of 60 days, the experimental plants were found to be growing much faster and vigorously with greater number of branches and very much enhanced leafiness as compared to the control. Earliness in flowering of about 2½ weeks was noted in the experimental plants with bigger fruits and bolder seeds as compared to the control.

Sesamum indicum : In this species also sound excitation had depressent effect on the vegetative performance of experimental plants for the first thirty days. After a lapse of 60 days here also the growth performance of the experimental plant in height, number of branches and production of leaves were found to be 18 per cent, 120 per cent and 444 per cent respectively superior to the control. Earliness of flowering of about one week was achieved in the experimental plants.

It is interesting to note that longevity of the experimental plants was enhanced in all the 4 species experimented upon as compared to the control.

107. Effect of shortday on the auxin content of shoot apex.

S. M. SIRCAR and MAYA KUNDOO, Calcutta.

An experiment was performed to study the effects of short photoperiods on the auxin content of the crown and the shoot apex of rice var. *Rupsail.* The auxin was assayed by Root Inhibition Test. Auxin content of the crown increases with age in the control as well as of the treated plants but declines when it begins to rise in the shoot apex. The auxin level of the short day treated apex reaches its maximum after four weeks photoperiods. While in the control shoot apex does not show such a rise. The amount of auxin in the treated shoot apex is much higher than that of the control. The reason for this high auxin content may be that at the critical stage of transition the changes of the shoot apex are very quick,

the inflorescence axis being increased by 400 μ in length within 24 hours, while in the control there was no such rapid change, but it is gradual. Auxin content of both the treated and the control apices show maximum thresh-hold value during ear emergence and after anthesis there is gradual fall.

108. Effects of auxins and antiauxin on the growth and development.

S. M. SIRCAR and MAYA KUNDOO, Calcutta.

Rice var. *Chinsura Boro 1* were cultured from seedling stage upto ear emergence in bottles containing nutrient solution with different concentrations of Indole Acetic Acid, Napthalene Acetic Acid, and Maleic Hydrazide. A control set was run along with these series in which there was only nutrient solution without any auxins and antiauxins. The container of these plants were covered with black paper and the mouth of which was plugged with a piece of non-absorbent cotton and thus the aerial organs of the plant was exposed to direct sunlight and air and the root system was under complete darkness. Air was supplied regularly to the root system for its normal respiration.

The number of roots in auxins at higher concentration is increased. As regards the toxic effect due to the application of higher doses of auxins and antiauxins it may be said that at a higher concentration of 10 p.p.m. of IAA, NAA plants survive only for a month but in the lower concentrations, plants show normal healthy growth of shoots. While in M.H. at 10 and 1 p.p.m. seedlings die after 1 month. In rest of the concentration they survived till ear emergence.

Regarding the leaf number it has been found that lower the concentration of IAA there is increase in the leaf number. There was normal tiller production both in IAA, NAA and MH. Auxin content of the different parts of these plants in culture solutions were studied by Root Inhibition test. It is interesting to note that in IAA, NAA & MH there was a slight early flowering observed.

ECOLOGY AND DISTRIBUTION

109. A Botanical Tour in Kashmir State.

T. ANANDA RAO, Dehra Dun.

The author undertook an exploration of the flora of Kashmir on behalf of the Botanical Survey of India during the Summer of 1956. The paper includes a brief account of the salient aspects of the flora observed during the months, June and July and a systematic census of the specimens collected. Botanically, the State falls into three regions, each presenting its own characteristic type of vegetation. In the Kashmir Valley, the Conifers, *Cedrus labani* Barrel var. *deodara, Pinus excelsa* and the broad leaved trees, *Juglans* sp., *Acer caesium, Aesculus indica, Parrotia jacquemontiana* are conspicuous in the forests. Several fruit trees are also cultivated in this region. In the Valley are found many beautiful lakes with characteristic hydrophytic formations and in which are found the 'floating gardens' supporting the growth of vegetables.

The mountains represent the coniferous belt on account of their dominance and under the shade of these Conifers a rich herbaceous and shrubby vegetation is developed. The herbaceous vegetation of the mountains present a wide variety of plants of economic importance.

In the alpine zone a rich alpine flora carpets the ground with its vivid colours. Collections were made from altitudes up to 5000 m in the Kolohai and Sonamarg glacial zones.

The total number of species of which specimens were collected in this tour is 550 of which 491 are Angiosperms, 7 Gymnosperms and 19 Pteridophytes. These are enumerated in the census along with brief descriptions and notes on their uses if any.

110. Fiber Yielding Weeds of Bombay and its suburbs. III—(a) Hibiscus tetraphyllus, Roxb. (b) Hibiscus esculentus, Linn. (c) Hibiscus rosasinensis, Linn.

S. M. BETRABET and B. S. NAVALKAR, Bombay.

While studying the physical and chemical properties of bast fibres, it was considered desirable to investigate fiber yielding plants other than jute with a view to find out the species available in Bombay and its suburbs, that could be used as substitute for jute.

From the preliminary observations and phytosociological study it was found that there are innumerable plants especially belonging to cohort Malvales, growing in abundance on waste lands of Bombay and its suburbs during monsoon. *Malachrs capitata* Linn. and *Abutilon indicum,* Sweet were the first and second respectively in the series and were already described in the previous papers. The third group of plants belongs to genus *Hibiscus,* as *H. tetraphyllum* Roxb. *H. esculentus* Linn. and *H. rosa-sinensis* Linn.

The habitat of *Hibiscus tetraphyllus* Roxb. is not very dirty. The nitrate positive plants indicate high nitrifying capacity and it resembles that of *Malachra capitata* Linn. It is a hairy and prickly annual shrub commonly grown on waste lands and is not cultivated. It has a high fiber content (10%), the fibers are light cream and coarse to feel. It has long ultimate cells (1·6 mm.) high L/D ratio (122) and low fat and wax content (0·343%). The cellulose content is 87·37 and the lignin content is 11·59%. The nitrogen content is low (0·139). The plant is inferior in its intrinsic strength (1·619 Gms/Denier) as determined by Schopper tester.

Hibiscus esculentus Linn. is an erect growing tall annual shrub, commonly cultivated as a garden or field crop. It is 4-5 feet high and has fiber content of 7·9% and is very economical as the fiber is extracted as a by-product after utilizing the plants fully for its fruits. The fibre's convulsions and other properties are like jute. It has long ultimate cells (1·8 mm.) low L/D ratio (103%) and poor fat and wax content. The cellulose content is high (81·89%), the lignin content is 16·94 and nitrogen content is 0·842%. It has poor intrinsic strength (1·514 Gms/Denier).

Hibiscus rosa-sinensis Linn. is an ornamental shrub of 5-8 feet high. The fiber content is 10·2%, the fibers are yellowish and coarse. The ultimate cell is 1·2 mm. L/D ratio is 104, fat and wax content is 1·707%, cellulose content is 82·96% and lignin content is 13·18%. The nitrogen content, is high (0·324) and has inferior intrinsic strength (1·62 Gms/Denier).

The fibers of the above plants may be given trial along with *Malachra capitata* and *Abutilon,* as jute substitute or can be mixed up in certain proportions.

111. Phytosociological Studies of the 'Ruderal Associations' of Bombay.

DR. F. R. BHARUCHA and K. B. JINDAL, Bombay.

Ruderal associations are found generally on waste places, cart tracks, waysides, footpaths, reclaimed areas and abandoned places. The increasing development of roads and gradual urbanization of the countryside have brought about a corresponding increase in the ruderal vegetation of this country, and as this aspect is becoming a major problem by itself, it was felt that a vegetation survey of this country should also take into account the ruderal vegetation.

The survey was conducted according to the method of Braun-Blanquet and Pavillard for about two years. This has revealed the existence of four definite ruderal associations. Since our four associations are all dominated by four different plants, we have named them after their dominant plant. Thus we distinguish four associations of :

1) Cassietum torii Bharucha or the Association of *Cassia tora* Linn.
(2) Malachretum capitatii Bharucha or the Association of *Malachra capitata* L.
(3) Hyptietum suaveolenii Bharucha or the Association of *Hyptis suaveolens* Poit.
(4) Sesbanietum bispinosii Bharucha or the Association of *Sesbania bispinosa* Faws. & Rend.

These four associations are classed in the order Abelmoschetalia manihotae and in the alliance of *Alysicarpus hamosae.* About 150 species of these associations were classified into seven groups namely : (1) characteristic exclusive : (2) preferential : (3) species of Alliance; (4) species of the Order; (5) Facies species; (6) companion species and (7) Accidental species.

The ruderal vegetation of Bombay is rich with more than two hundred species and is purely seasonal and flourishes during the monsoon. After October all the plants constituting it begin to dry up and by January the vegetation totally dries up except a very few survivors such as *Blumea eriantha, Bothriochlea pertusa, Alternanthera sessilis* and *Cynodon dactylon.*

112. Grasslands and effect of grazing in Manipur.

D. B. DEB, Agartala, Tripura.

This paper presents a discussion on the grasslands and effect of grazing in Manipur, on the basis of field study and analysis of the component floristic elements Four associes have been recognized and described.

(1) *Imperata-Saccharum-Themeda* associes is dominated by *Imperata cylindrica, Saccharum arundinaceum, Saccharum spontaneum, Themeda villosa, Narenga porphyrocoma, Cymbopogon khasianus, neurandia reynaudiana, Apluda mutica, Arundinella bengalensis, & Ophiurus,* sp. Other plants associated with these are *Plectranthus ternifolius, Crotalaria striata, Crotalaria humifusa, Smithia sensitiva, Aeschynomene indica, Anisomeles obovata, Anisochilus polystachya, Centranthera hispida, Uraria lagopodioides, Desmodium laxiflorum, Eupatorium odoratum & Leea crispa.*

(2) *Phragmites-Saccharum-Narenga* associes is characterised mainly by *Phragmites karka, Saccharum arundinaceum,* and *Narenga porphyrocoma.* Other associates are *Sclerostachya fusca Leersia hexandra, Apluda aristata, Echinochloa stagnina. Ipomoea kingii, paederia foetida, Ipomoea liniata Ipomoea bonanox, Thunbergia allata, Phaseolus calcaratus, Cissus pedata, Melothria heterophylla, Bryonopsis lasiniosa, Cissumpelos pareira* are the climbers growing in this associes.

(3) *Cymbopogon-Heteropogon-Bothriochloa* associes growing at about 2800-4000 ft. altitude, is dominated by *Cymbopogon khasianus, Heteropogon contortus* and *Bothriochloa intermedia.* Other commonly occurring plants are *Arundinella decempedalis, Arundinella nepalensis, Sporobolus indicus* (?), *Neuraudia reynaudiana, Garnotia emodi, Polytoca digitata, Capillipedium* Sp., *Panicum tripheron, Paspalum scrobiculatum, Themeda* sp., *Crotalaria alata, Crotalaria ferruginea, Desmodium triquetrum, Desmodium laxiflorum, Urarialagopodioides* and *Indigofera pulchella.*

(4) *Bothriochloa-Eragrostis* associes seen at Karaspokpi is dominated by *Bothriochloa intermedia, Eragrostis nigra, Eragrostis unioloides, Themeda villosa, Brachiaria villosa, Sporobolus diandra, Sporobolus indica* and *Thysanolaena maxima.* Other less frequent ones are *Imperata cylindrica, Digitaria pruriens, Polytoca digitata,*

Apluda aristata, Ophiuros megaphyllus, Arthraxon sp., *Juncus prismatocarpus, Coelachne simpliciuscula, Ulalia fulva, Rhynchospora gracillima, Sclereia annularis and Sclereia pergracile.*

Predominating the grazing grounds, occur *Chrysopogon aciculatus, Imperata cylindrica, Paspalum scrobiculatum* and *Cynodon dactylon. Fimbristylis diphylla, Juncus Prismatocarpur* and *Cyperum kyllingia* grow in the depressions. A large number of dicotyledonous plants are scattered here and there. These plants have been enumerated in the paper.

113. Vegetation near habitations in Manipur.

D. B. DEB, Agartala, Tripura.

This paper attempts an analysis of the floristic composition of the vegetation near habitations in Manipur subjected to diverse biotic and anthropogenic influences.

1. *Bund flora* :—This is dominated by *Eragrostis unioloides, Paspalum scrobiculatum, Echinochloa crusgalli, E. crus-pavonis, E. coloratum, E. stagnina, Eleusine indicum, Jussiaea suffruticosa, Ludwigia parviflora, Melochia corchorifolia, Brachiaria villosa, Desmodium triflorum, Cyperus distans, Murdannia nudiflora, Centella asiatica, Oxalis corniculata, Ottelia alismoides, Scirpus mucronatus, Alternaria sessilis, Polygonum lapathifolium, P. orientale, Fagopyrum esculentum, Selaginella* sp., *Fimbristylis diphylla, Eriocaulon najadis, E. cinereum, Rotala rotundifolia, Lindernia anagallis L. crustacea.*

2. *Puddle flora* :—Hydrophytes form the main vegetation. The most common ones are *Hydrilla verticillata, Monocharia hastata, M. vaginalis, Sagittaria sagittifolia, S. guayanensis, Ottelia alismoides, Ipomoea repens, Scirpus mucronatus, Juncus prismatocarpus, Utricularia flexuosa, U. exoleta, Ceatophyllum demersum.*

3. *Rice field flora* :—Small *hydrophytes* and hygrophytes manage to grow along with rice. *Utricularia flexuosa, U. exoleta, Limnophila chinensis, L. hypericifolia, Hymenachne interrupta, Lemna minor, spirodela polyrrhiza, Oryza sativa var. fatua,* are very common. During the cold weather after the harvest large number of herbaceous annuals appear, which complete the life cycle within few months. 26 species have been enumerated, the most common of which are *Hydrolea zeylamica, Eclipta alba, Rotala rotundifolia, R. indica, Torenia vegans, T. peduncalata, Lindernia cristata, Mollugo lotoides, Hypericum japonicum* and *polygonum* sp.

4. *Vegetation of fallow rice fields* :—When the rice field is left uncultivated for one year, it produces a vegetation *dominated* by *Cyperaceae, Gramineae* and *Compositae,* in addition to those named above, when the land remains uncultivated for two or more years, the hardy and shrubby vegetation gradually follows the succession. The most common of these are *Solanum indicum, S. nigrum, S. ferox, Leucas linifolia, Clerodendron infortunatum, Physalis pernviana, Gynura crepidioides, Acanthospermum hispidum, Amaranthus spinosus, Achyranthes aspera, Mimosa pudica, Cassia tora, Cassia occidentalis Acacia fernasiana, Vitex trifolia* and a host of others.

5. *Terraced paddy/field* in the fallow season studied at Mae and Marem at about 5000 ft. altitude, indicates the dominance of *Gramineae* and *Cyperaceae* amongst 17 common species enumerated.

6. *Hedge plants* :—Cultivated areas near pastures and thoroughfares are protected by hedge plants which give shelter to climbers and others. 30 species forming such an association have been enumerated.

7. *Abandoned jhum land* :—Studies indicated that the first immigrants to take possession of this land are species of *Compositae* and *Gramineae.* Then others from the neighbouring forest follow. 20 such species have been enumerated.

114. Hydroseral Communities of Manipur.

D. B. DEB, Agartala, Tripura.

This paper presents the hydroseral communities of Manipur classified into five categories in view of the quantity of water available. Altogether 101 species have been found to associate themselves in these communities.

(1) Those found in areas containing stagnant water all the year round, i.e., pools, tanks and lakes which do not dry up. Zonation is a characteristic feature. The free floating vegetation of deep water is surrounded by rooted species of shallow water. The marginal vegetation and the terrestrial species are so set up that each species comes to occupy the optimum habitat. *Nelumbo nucifera* (except Logtak lake), *Euryale ferox, Nymphaea pubescens, N. stellata, N. pygmea,* (rare) etc. form large socies with root stocks sunk under the mud and large leaves and flowers raised above or floating on the surface of water. *Salvia natans, Salvia cucullata, Riccia natans, Spirodella polyrrhiza, Lemna minor, Lemna trisulca, Wolffia arhiza, Pistia stratoites, Eichhornia crassipes* are floating. *Hygroryza aristata, Oryza sativa* var. *fatua, Cyperus cephalotes* etc., form dense mats. *Trapa natans, Vallisneria spiralis, Hydrilla verticillata, Potamogeton crispus, Utricularia flexuosa, Ceratophyllum demersum* etc., form the submerged vegetation. Towards the margin *Ipomoea reptans, Jussaea repens, Ottelia alismodes, Limnanthemum indicum, Monochoria hastata, M. vaginales, Leersia hexandra, Panicum paludosum, Echinochloa crusgalli, Paspalum scrobiculatum, Cyperus pilosus, Pycreum globosum, Eleacharis palustris, Fimbristylis diphylla, Phragmites karka, Saccharum spontaneum, Narenga porphyrocoma, Typha elephantina, Imperata cylindrica* and a host of others.

(2) Those found in areas which are dry in the cold water and flooded during the rains. When dry such areas show a distinct vegetation of the grass land associated with a large number of herbaceous weeds, while in other areas weeds of the rice field grow. The rain vegetation depends largely upon the depth of water and the rapidity with which it rises. When the depth of water is upto 1 ft. vegetation is composed mainly of *Gramineae* and *Cyperaceae* associated with floating marginal vegetation of the pond. When the depth is up to 4 50 ft. the submerged and other plants follow.

(3) Those found in areas which are moist in winter and periodically flooded during rains. *Saccharum spontaneum* and *Phragmites karka* colonise first. Others which follow are *Crotalaria striata, Aeschynomene indica, Torenia vagans, Fragaria indica, Ludwigia parviflora, Polygonum plebejum, Amaranthus spinosus, Pueraria subspicata* and *Ipomoea kingii.*

(4) Those found in areas lying between high and low water level. Plants which are adapted to withstand submersion for several months, grow in this situation. *Homonoia riparia* and *Rhabdia lycioides* are characteristic perennials. Annuals which are not only restricted to such a situation are also plenty.

(5) Those found in areas formerly under water, which are dry in cold weather and are not flooded during rains. Most of the alluvial plains of the valley which bear tree forests of various types of valley bushes and grass come under this category. These have been taken up elsewhere in a separate paper.

115. Seral communities in Manipur.

D. B. DEB, Agartala, Tripura.

Seral communities in Manipur, studied during 1951-55, are presented in this paper. 5 seral units are described. After considering the locality and habitat factors, floristic elements are analysed and reactions are indicated.

(1) *Dalbergia-Acacia* hylis is dominated by *Dalbergia thomsoni, Dalbergia tamarindifolia* and *Acacia pruinescens. Leucaena glauca, Caesalpinia bonducella, Albizzia procera, Salmolia malabaricum, Butea minor, Zizyphus mauritiana, Emblica officialis* and *Vangueria spinosa* are also common in drier regions. *Saccharum spontaneum* and *Narenga porphyrocoma* are the commonest grasses growing in the earlier stage.

(2) *Glochidion-Cephalenthus* hylis is characterised by *Glochidion hirsutum, Glochidion velutinum, Glochidion multiloculare, Cephalenthus occidentalis, Melastoma malabathricum, Oxyspora vagans, Polygonum orientale, Osbeckia chinensis* and *Osbeckia capitala* are common. *Phragmites karka, Saccolepis interrupta, Leersia hexandra* and *Hymenachne pseudo-interupta* are the grasses frequently found. Due to the development of this community soil is accumulated and gradually the surface level rises.

(3) *Syzygium and others* hylis is characterised by *Syzygium cumini, Emblica officinalis, Gmelina arborea, Bridelia retusa* and *Bridelia tomentosa. Of the shrubs* the most common are *Glochidion assamicus, Leea aspera, Antidesma diandra, Vitex trifolia* and *Adhatoda vasica. Osbeckia stellata, O. chinensis, Knoxia corymbosa, Crotalaria alata, Breynia patens, Costus speciosus, Hedychium* sp. *Mussaenda glabra, Mussaenda frondosa, Clerodendron serratum, Plectranthus ternifolius* and *Urena lobata.* Common grasses are *Imperata cylindrica, Saccharum spontaneum, Paspalum scrobiculatum, Heteropogon controtus* and others. *Fimbristylis diphylla* and *Fimbristylis dichotoma* are common sedges.

(4) *Duabanga-Terminalia* hylis is dominated by *Duabanga sonneratioides* and *Terminalia myriocarpa.* Other associates are *Salmolia malabaricum, Salmolia insigne, Bauhinia variegata* and *Bauhinia purpurea, Oroxylum indicum, Gmelina arborea, Talauma hodgsoni, Turpinia pomifera, Cinnamomum obtusifolium, Antidesma bunius, Litsea khasiana, Albizzia lucida* and *Dillenia indica.* Herbaceous layer is made up of *Costus speciosus, Allophyllum cobbe, Strobilanthes coloratus, Baliospermum corymbiferum. Calamus tenuis, Poruna paniculata, Thunbergia alata* and *Cissus repanda.*

(5) *Swamp and creeper forest* is dominated by *Litsea khasiana, Litsea kurzii, Drimycarpus racemosus, Vatica lancaefolia, Glochidion assamicum.* The most common creepers and herbs are—*Kadsura roxburghii, Stephania hernandifolia, Cissampelos pareira, Thunbergia alata, Thunbergia grandiflora, Aspidocarya unifera, Roydsia suaveolens, Hibiscus fragrans, Hibiscus radiatus, Aspidopteris roxburghiana, Toddalia asiatica, Gouania leptostachya, Tetrastigma serrulatum, Cissus elongata, Cissus repanda, Tapiria hirsuta, Millettia pacnycarpa, pueraria subspicta, Entada phaseoloides, Illigera khasiana, Uncaria* sp., *Paederia foetida, Jasminum sambac, Porana paniculata* and *Costus speciosus.*

116. Studies in Succession of Vegetation in Manipur.

D. B. DEB, Agartala, Tripura.

Conditions which facilitate studies in succession of vegetation in Manipur are pointed out.

Causes of succession on bare areas—migration, aggregation, ecesis, competition, reaction, edaphic factors (partly) and biotic factors are discussed.

Dispersal mechanism of flowering plants which plays the most important role in migration, succession and distribution of plants is taken up in full details.

The successional units studied are :—

(1) *Dalbergia-Acacia* hylis.
(2) *Glochidion-Cephalenthus* hylis.
(3) *Syzygium and others* hylis.
(4) *Duabanga-Terminalia* hylis.

(5) *Swamp and creeper* forest.
(6) *Imperata-Saccharum-Themeda* associes.
(7) *Phragmites-Saccharum-Narenga* associes.

117. Weeds and Exotic plants of Manipur.

D. B. DEB, Agartala, Tripura.

This paper presents a study of weeds and exotic plants of Manipur. The weeds have been classified into three categories. 21 'Dry land weeds', 21 'Wet land weeds' and 23 'Waste land weeds' have been enumerated.

Origin, immigration and distribution of the following 6 species have been discussed (1) *Eupatorium odoratum*, (2) *Ageratum conyzoides*, (3) *Gynura crepidioides*, (4) *Eichhornia crassipes*, (5) *Lantana camara* and (6) *Argemone mexicana*.

118. The flora of Lucknow and its environs.

RAMAKANT P. PATIL, Lucknow.

The indigenous vegetation of Lucknow on the Upper Gangetic Plain should have marked affinities with that of the Indus Plain and the adjoining area of Peninsular India, i.e., it should be that of a dry country having leafless trees and burnt up herbs in the dry season. In Lucknow and its environs the indigenous vegetation has been replaced largely by a flora directly or indirectly fostered by man.

Some two hundred species occurring in this area are mentioned by name and they are conveniently classified as roadside trees, trees in parks and gardens, trees in orchards, hedge plants, field crops, lawn and pasture flora, waste land herbs and shrubs, hygrophilous herbs and undershrubs, and hydrophytes.

Observations on the flora of Lucknow and its environs give no definite clue as to the vegetation that should constitute its climatic climax, viz., an open deciduous forest. This is chiefly to be attributed to the numerous evergreen trees planted. Irrigation practices and the arrival and multiplication of hardy evergreen shrubs like *Lantana camara* L. and *Croton sparsiflorus* Morong have contributed to the making of a more verdant landscape for the hot season.

119. The dry deciduous forests of Thana district, Bombay.

S. K. JAIN and S. M. KARMAKAR, Poona.

The deciduous forests of Thana district are situated almost along the main Bombay-Agra Road. The altitude of these forest areas varies from about 250 to 700 meters above the sea level. The sub-stratum is mainly Deccan trap with outcrops of basalt and red clay on the surface. The area receives an annual rainfall of about 250 cms. The area is thinly populated. The forests are reserved but generally open to grazing.

The typical deciduous forest is composed of *Tectona grandis* Linn., *Terminalia tomentosa* Clke community. The common associates are *Anogeissus latifolia* and *Butea monosperma* O.K. *Adina cordifolia* Hk. and *Schleichera oleosa* Merr. are frequent in Vihigaon area.

The second storey consists mainly of *Erythrina variegata* Linn., var. *orientalis*, *Salmalia malabarica* Sch. & End., *Butea monosperma*, *Wrightia tinctoria* R. Br. *Acacia catechu* W. & A., *Bauhinia racemosa* Lam., and *Zizyphus rugosa* Lam. The shrub layer consists of *Flacourtia* species, *Woodfordia fruticosa* Kurz., *Meyna laxiflora* Roxb., *Carissa congesta* Wt. etc.

The commonest climbers in the area are :—*Calycopteris floribunda*, Lam., *Combretum* spp., *Hemidesmus indicus* R. Br., *Mucuna prurita* Hk., *Cryptolepsis buchanani*, R.S., *Dioscorea bulbifera* Linn., *Dioscorea pentaphylla* Linn., and some cucurbits. *Dendrophthe* species are commonly met with parasitising a number of trees, chiefly *Terminalia tomentosa* Clke.

The ground vegetation shows a distinct aspect and the following species occur mainly during and after monsoons :—

Alysicarpur sp. *Anotis lancifolia* Hk., *Cassia absus* L., *Cassia tora* Linn., *Cyperus* sp., *Euphorbia parviflora* L., *Phaseolus* sp., *Melothria* sp., *Hypoxis aurea* Lour., *Crinum* sp., *Urena lobata* Linn., *Justicia simplex* Don., *Phyllanthus niruri* L., *Arthraxon* sp., and some other grasses.

Adiantum sp. is a common fern. *Habenaria grandiflora* Lindl., the ground orchid is quite common in rainy season. Seedlings of *Adina cordifolia* Hk., *Butea monosperma*, *Carissa congesta*, *Acacia catechu*, *Bauhinia racemosa*, *Erythrina variegata* var. *orientalis*, *Tectona grandis*, *Cassia fistula* L., *Terminalia tomentosa* and others are frequently met with.

Plants like *Malachara* sp., *Urena lobata*. *Achyranthes aspera* L., *Cyperus* sp., species of *Capillipedium*, *Themeda*, *Arundinella Apluda*, *Ischaemum* and *Heteropogon* grow during the hot and dry seasons.

The *teak-Terminalia* community seems to be the climatic climax in this area.

The paper includes a Table showing percentage occurrence of common species as studied in the transects laid in different areas, and a number of photographs of the vegetations.

120. Plant community in low-lying areas of Sagar.

L. P. MALL, Sagar.

An ecological study of Plant Community growing in low-lying areas of Sagar and suburbs has been made. These low-lying areas remain covered with water during rainy season but become dry in summer. During the last phase of drying of such areas there emerges a crop of seedlings which develops into a characteristic flora as the bed dries. Most of the members of the community grow prostrate, appressed to the ground. This is probably in response to intense light because plants grown in shade become more or less erect.

In the areas, which have been studied *Heliotropium supinum*, *Polygonum plebejum*, *Chrozophora prostrata*, *Crypsis aculeata*, *Gnaphalium pulvinatum*, *Sphaeranthus indicus*, *Trigonella occulta*, *Cochlearia flava*, *Polanisia chelidoni*, *Scirpur michelianus*, *Nasturtium indicum*, *Mollugo lotoides*, *Althaea ludwigii*, *Polypogon monospeliensis* are exclusive species. All these together with *Sutera glandulosa*, *Argemone mexicana*, *Potentilla supina*, *Chrozophora rottleri*, *Voluterella divaricata* are characteristic species of the community.

The seedlings of these species come up in October or later coinciding with the period of drying of water. Flowering starts from January and fruits are formed in March, April and May.

The stomatal frequency of some important species has been found out which is quite high. Hairy covering is also a common feature. The osmotic concentration of cell sap goes on increasing as the soil dries, reaching a maximum of 28 atm. in the case of *Chrozophora prostrata*. The soil of such areas is basic in reaction and rich in calcium. It is very heavy due to very high fraction of silt and clay.

121. Flora of the Bashahar Himalayas.

G. S. PURI, Poona.

Bashahar is located in the Western Himalayas at Latitude between 31°6′ N and 32°4′ and at Longitude between 77° E and 79°3′ E. This is a mountaineous country, with high mountains and valleys. The range of altitude is from 4000 to 14000 ft.

In the outer hills there is heavy monsoon rainfall and the main rocks are Schists. The strata of the rock dip at various angles towards North and North-East. The inner valleys have less rainfall, but heavy snow-fall and the rocks there are mainly granite. In this area, there are no seepage planes in the rocks. There are glacial moraines and Flood Plain Deposits in the area which show distinct types of vegetation.

The vegetation of the Bashahar Himalayas comprises the three climax communities of oaks viz , *Quercus semecarpifolia, Quercus incana, Quercus dilatata* and *Quercus ilex*. Over a large part of the area, due to shifting cultivation, felling and burning, the oak climaxes have been destroyed, giving rise to numerous mixed communities. There are oak conifer communities which are edaphic or bio-edaphic in nature. All the communities occurring in the area have been described in detail. Plants have been collected from these communities and identified. In all there are 1199 plants recorded from the Bashahar Himalayas. Ecological notes of these plants have been given in detail.

Most of the Bashahar area is unexplored botanically and in Flora Simlensis Collett has given a few species from the Bashahar Himalayas. In this list which is now presented there are as many as 500 species which are not mentioned in Collett's Flora. The paper is illustrated by photographs and gives details on the environment.

122. Observations on the vegetation of Kutch.

G. S. PURI and S. K. JAIN, Poona.

Kutch is situated approximately between the latitudes 20°·51 N and 24°·25 N and longitude 68°·25 E and 71°·38 E.

Geologically Kutch is very interesting and vegetation seems to be related to geological features. There is also a great variety of soils. The central portion of the state has red and yellow soils; little towards south there are areas with medium black soil formed from trap and gneissic rocks. Vast tracts all along the south and south west coast have alluvial saline soils. In the north and east also a wide area is under saline soil, the Great and the Little Rann of Kutch.

In the middle of the state are low hills and rocky plains. Dhinodhar hill is the highest hill.

Dhinodhar hill supports a vegetation somewhat resembling the vegetation of the dry, deciduous forests in the Sahyadris in Bombay state such as a community of *Odina wodier* Roxb., *Euphorbia* species, *Moringa oleifera* Lamk, *Salmalia malabarica* Schott & Endl., *Capparis* sp., *Cordia myxa, Lawsonia inermis* Linn., *Ficus* species, *Vitis trifoliata* Linn., *Gymnosporia montana* Benth., *Acacia* species, etc.

Around Dhinodhar, as also in the other areas with red rocky soils on the hillocks the vegetation is thorny scrub, composed of a community of *Acacia catechu* Willd., *Acacia leucophloea* Willd. The chief associated species are :—*Grewia populifolia* Vahl, *Grewia villosa* Willd., *Euphorbia nerifolia* Linn., and *Premna integrifolia* L. *Tragia* is a very common climber in this community. *Barleria prionitis* Linn., *Peristrophe bicalyculata* Nees., *Justicia heterocarpa* And., *Justicia diffusa* Willd. *Aristida adscenscionis* Linn., and *Apluda varia* Hack., grow abundantly. This community was studied at Mevo-rakhal, Bhujia hill, Bhivandyara and hills near Bhuj.

Several degraded stages of this scrub vegatation are seen on over grazed hills. The waste places particularly those with saline soil are colonized by a community of *Butea monosperma* Ktze., and *Cassia species.* In still more saline hills a dense *Salvadora-Tamarix* community is commonly found. *Calotropis procera* R. Br., and *Indigofera* species commonly grow in this community.

The saline tracts in the north, commonly known as Banni grasslands spread for about 1500 square kilometres and support vast grasslands to feed the cattle of Kutch. *Phoenix sylvestris* Roxb., *Prosopis specigera* Linn., tall *Typha* bushes, grasses and sedges grow healthy along nalas and in the moist situations.

There are small areas under mangrove vegetation on south coast such as at Mundra. *Avicennia alba* is the dominant species forming this vegetation. Several halophytes such as *Sueda fruticosa. Helochloa* and *Salicornia* etc. grow near mangrove areas. The paper includes a Table showing occurrence of different common species recorded in transect studies, and a number of photographs of vegetation.

123. Flora of the Aravalli Hills at Abu.

G. S. PURI and S. K. JAIN, Poona.

Mount Abu is situated on the border between Bombay and Rajasthan at the south-western extremity of the Aravallis separated from the main range by a valley about 24 kilometres wide. The average altitude of Mount Abu is about 800 metres above sea-level. The top of the hill is an irregular plateau about 22 kilometres long and 7 kilometres broad.

The average annual rainfall is about 175 cms. The mean temperature for May is about 80°F.

The vegetation, in general, is moist deciduous. The following communities are commonly met with :—

Anogeissus-Carissa and *Euphorbia* community, the commonest type is met on hill tops and slopes chiefly southern and eastern. The huge granite boulders support tall *Euphorbia* bushes. *Anogeissus* and *Carissa* grow in the secondary soil amongst these boulders. Common tree species are *Anogeissus pendula* Edgew., *Anogeissus sericea* Brand., and *Anogeissus latifolia* Wall. *Erythrina suberosa* is commonly associated. Trees of *Mangifera indica* Linn., *Mallotus philippinensis* Muell., *Syzygium cumini* Skeels. and *Ficus* species are also met with. *Carvia callosa* Brem. is the most abundant shrub in the undergrowth.

The second common community is formed of *Syzygium cumini* Skeels., *Mangifera indica* L., and *Erythrina suberosa* Roxb. It is met with in valleys and depressions on deeper soil, also in moist situations in northern and western slopes. *Euphorbia* is almost absent. The ground is covered, during rains, by a thick layer of debris of fallen *Syzygium* and *Mango* leaves and there is almost no ground vegetation. Trees of *Mallotus philippinensis* and *Bauhinia racemosa* also are frequently present. *Carvia callosa* and *Carissa* species are the commonest shrubs in this type.

A small area below Bhimali hill is reserved forest where trees of *Erythrina, Kydia calycina* Roxb., and *Capparis,* are frequently present. The undergrowth is dense consisting of *Carvia callosa,* and seedlings and saplings of *Desmodium, Moghania, Pueraria, Impatiens,* etc.

The open places on the hills and the forest fringes are colonized by abundant growth of the spiny shrub *Caesalpinia sepiaria.* This shrub is among the commonest plants on the plateau and during rainy season its seeds sprouting in situ in split pods are conspicuous. *Jasminum* species, *Solanum seaforthianum* T. And. and a number of other climbers grow over *Caesalpinia* bushes.

The open flat areas and waste places are colonized by *Solanum xanthocarpum*, *Lantana camara*, *Lantana indica* and other weeds. *Dyerophyton indicum* O. Ktze. of Plumbaginaceae grows on rocks and walls of old houses. *Phoenix sylvestris* Roxb. is found frequently growing in and near town as also in some forest areas. Its presence at this altitude is attributed to biotic influence such as fire and presence of quartzite rocks.

Two species of *Eucalyptus*, *Grevillea robusta* A. Cunn., *Pinus roxburghi* Sarg., *Cupressus* species, *Lagerstroemia* species, *Jacaranda ovalifolia* and *Callistemon lanceolatum* are commonly grown as ornamental plants.

The paper includes list of plants collected and reported from Mount Abu, a map showing the areas explored and also photographs of vegetation.

124. Dry deciduous forest of Khandesh.

G. S. PURI and S. D. MAHAJAN, Poona.

Dry deciduous forest occurs in the hilly areas of Khandesh, and the outer ranges of Satpuda Mountains in the northern belt of E. Khandesh. The Ranges of Satpuda are composed of trap rock and the hills run east-west through Raver, Yawal and Chopda Ranges. The slopes of the hills are generally gentle, but precipitous scarps and deep valleys are also frequent.

The soil is generally shallow and gravelly over the slopes and the rock outcrops at places. In the valleys and plains the soil is deep chocolate in color and is clayey mixed with gravel.

The climate is hoty and dry during the major part of the year. Average annual rainfall varies beteen 61 cms. and 85·5 cms.

In the interior region of Satpuda Ranges, the forest is considerably dense and continuous. The outer hillocks on the contrary have a scattered deciduous forest with open patches and scrub areas, due probably to excessive cutting and felling.

The deciduous forest comprises *Boswellia serrata* in hills and *Hardwickia binata* in the plains and valleys, in general.

In some areas, however, mixed communities of *Boswellia serrata* and *Hardwickia binata* are not uncommon.

Following is the list of plants occurring in *Boswellia-Hardwickia* community :—

TREES :- *Acacia catechu* Willd., *Anogeissus latifolia* Wall., *Bassia latifolia* Roxb., *Bauhinia racemosa* Lam., *Boswellia serrata* Roxb., *Buchnania latifolia* Roxb., *Cochlospermum gossypium* DC., *Dolicandro falcata* Seem., *Gmelina arborea* Linn., *Hardwickia binata* Roxb., *Ixora parviflora* Vahl , *Moringa citifolia* Linn., *Moringa pterygosperma* Gaertn., *Odina wodier* Roxb., *Salmalia malabarica* (DC.) S. & E., *Sterculia urens* Roxb., *Tectona grandis* Linn., *Terminalia arjuna* W. & A., *Terminalia tomentosa* Bedd., *Zizyphus xylopyra* Willd.

SHRUBS :—*Acacia catechu* Willd., *Acacia intsia* Willd., *Barleria prionitis* L., *Dichrostachys cinera* W. & A., *Gymnosporia montana* Benth., *Helicteres isora* L., *Grewia tiliaefolia* Vahl., *Mimosa hamata* Willd., *Nyctanthus arbor-tristis* L., *Zizyphus jujuba* Lam., *Zizyphus rotundifolia* Lam., *Zizyphus xylopyra* Willd.

HERBS :—*Achyranthes aspera* L., *Amaranthus spinosus* L., *Aristida setacea* Retz., *Apluda arista* Hack., *Cassia tora* L., *Cymbopogon martinii* Wat., *Glossocardia linearifolia* Cass., *Heteropogon contortus* Beauv., *Indigofera cordifolia* Heyne., *Ocimum canum* L., *Rungia parviflora* Nees., *Scilla indica* L., *Tridax procumbens* L., *Vernonia cinera* Less.

125. Vegetation of the Kurans. (Grassy Scrub Vegetation in Khandesh).

G. S. PURI and S. D. MAHAJAN, Poona.

Kurans are the grassy scrub areas in the Deccan Trap country of Khandesh, the best example of which is the Laling Kurans, about 8 miles from Dhulia in West Khandesh.

The vegetation is a scattered scrub with extensive patches of grasslands developed in a rolling type of country cut off by a number of water streams. There are numerous high trap hills which stand out prominently in the area.

The soil is generally shallow and gravelly with outcrops of trap to the surface frequently.

The climate is hot and dry, the maximum temperature at times reaching up to 118°F. Annual average rainfall varies from 49 cms. to 73·5 cms. and it is restricted to the monsoon season only.

Over the slopes of the several hills, a poorer and scattered type of dry deciduous forest is met with, and it mainly comprises *Boswellia serrata, Hardwickia binata, Odina wodier* and *Acacia catechu* trees.

The following species enter the scrub vegetation and occur commonly in the area :—

Acacia catechu Willd., *Acacia leucophloca* Willd., *Dichrostachys cinera* W. & A., *Grewia tiliaefolia* Vahl., *Euphorbia nivulea* Ham., *Euphorbia nerifolia* Linn., *Hardwickia binata* Roxb., *Gymnosporia montana* Benth., *Mimosa hamata* Willd., *Rhus mysorensis* Hyne., *Zizyphus jujuba* Lamk., *Zizyphus xylopyra* Willd.

In the grassy herbaceous flora, various composites, legumes, sedges and other herbs are abundant along with the grasses among which the following are the most common :—

Actinopteris dichotoma Bedd., *Andropogon annulatus* Forsk., *Andropogon pumilus* Roxb., *Aristida funiculata* T. & R., *Aristida setacea* Retz., *Apluda varia* Hack., *Boerhaavia diffusa* Linn., *Chlorophytum attenuatum* Baker., *Chlorophytum tuberosum* Baker., *Celosia argentea* Linn., *Evolvulus alsinoides* Wall., *Cynodon dactylon* Pers., *Eclipta erecta* Linn., *Eleusine aegyptiaca* Gaertn., *Gynandropsis pentaphylla* DC., *Heteropogon contortus* Beauv., *Indigofera cordifolia* Heyne., *Scilla indica* Linn., *Tridex procumbens* Linn.

The conspicuous feature during the rains is the presence of *Chlorophytum* and other liliaceous patches in grasslands and over the slopes of the hills. *Chlorophytum tuberosum* and *Chlorophytum attenuatum* are the common species and among other Liliaceae, *Scilla indica* is the most common.

The vegetation is a biotic community and the regeneration of the various species is present in the area.

126. The grasslands of the low rainfall areas in Maharashtra.

G. S. PURI and J. A. VASAVADA, Poona.

In Maharashtra, there are two types of grasslands, usually found where the forests have been cut or the soil is not deep enough to allow growth of trees. These grasslands can be divided into two types, (1) High rainfall tract grasslands and (2) Low rainfall tract grasslands.

In this note studies are presented of the low rainfall grasslands type that were studied in the vicinity of Poona, Chakan, Sholapur Road and Ahmadnagar Road.

Here the soil is very poor and rocky being hardly about ¼ meter deep. It is made up of disintegrated basalt or amygdaloid and is brownish yellow in colour. It is coarse, granular and porous. It generally is hard and not capable of retaining moisture.

The annual rainfall in the tract is below 49·00 cms. and the temperature varies between 10°C. and about 44°C.

The grassland communities are mainly *Lophopogon tridentatus-Apluda varia* communities with other species such as *Themeda triandra, Crotalaria orixensis, Indigofera cordifolia,* etc. growing along with. In some places pure patches of *Heteropogon contortus,* etc. are met with. At Chakan, however, a few shrubs such as *Gymnosporea montana, Euphorbia antiquorum, Lantana camara,* etc. are found.

These are much disturbed grasslands with heavy grazing.

The grass species are mainly coarse and not palatable.

In extremely hard and rock areas, especially on the top of the low hills *Aristida funiculata* grows almost pure, commonly with *Cyanotis, Commelina, Scilla,* etc. found in places with a little soil.

The areas are fit only for sheep and goat grazing. These studies were made in quadrats and the vegetation is charted.

127. The Teak Forest of the Poona District.

G. S. PURI and J. A. VASAVADA, Poona.

The teak forests are developed on the alluvium of the Ghod nadi and the basalt hils near Dimbha--a village at the foot of the Pokhri ghat.

The colour of the soil with alluvium patches is brownish due to the mixture of the decomposing amygdaloidal and basalt rocks; the basalt soils are usually black in colour. The depth of the soil varies from ⅓ meter up to 1½ meters, but the alluvial soils are much deeper.

The teak belt on the alluvium of the Ghodnadi decreases up the Pokhri ghat; and at the crest it is absent. The belt runs from around Dimbha to Shinoli in the east and Ambegaon and beyond in the North.

The rainfall varies between 30″-40″ on average and the temperature about 8°C to about 33°C.

The vegetation consists mainly of *Tectona grandis*. The other main species are *Santalum album, Anogeissus latifolia, Garuga pinnata, Acacia catechu, Heterophrogma roxburghii,* etc.

The common shrubs and climbers are *Carissa congesta, Clematis triloba, Euphorbia antiquorum, Lantana camara, Cryptolepis buchanani, Gymnosporea montana* etc.

The herbs and the grasses consist mainly of the following species—*Apluda varia, Bothriochloa* sp., *Arundinella tenella Cassia tora, Ageratum conyzoides Lavandula burmanni, Biphytum sensitivum, Aeschynomene indica* etc.

The teak forest here is an edaphic community preserved by the nature of the soil, and geological features.

128. On a collection of plants from North Garhwal, Uttar Pradesh.

M. A. RAU, T. A. RAO and Y. K. SARIN, Dehra Dun.

During the summer of 1957 some parts of North Garhwal, U.P. were visited for the collection of plants for the Botanical Survey of India. Plants were collected from, among other places, the Mana and Vasudhara valleys, the Charanapaduka valley at the foot of Mt. Nilakanta glaciers, the Bhyundhr forest and the hill slopes around Badrinath. The areas visited ranged in altitude between 1500 and 4000 metres. On account of unusual snow falls during the month of May, some areas even at 3600 metres were still under snow and altitudes higher than 4000 metres could not, therefore, be explored. The present paper includes a brief account of the general aspects of vegetation in the places visited and a preliminary list of 218 species collected during the tour. These species are represntative of 64 families and 169 genera of the Angiosperms, Gymnosperms and Pteridophytes.

129. A preliminary note on the revision of Indian Commelinaceae.

ROLLA SESHAGIRI RAO, Shillong.

In spite of a few earlier works on the family, there exist several ambiguities with reference to many Indian species of Commelinaceae and hence the revision has become necessary. The family at present conssits of 9 Indian genera, comprising 68 species distributed in different parts of India. Types of most of the species and the synonymy have been examined.

The utility of the characters of floral symmetry, staminode and its position, spathe, capsule, seed and root as partly worked out for the clarification of African species of *Commelina, Aneilema* and *Murdannia* by Morton, Brenan and others is being attempted in the present revision together with cytological and embryological characters as far as possible for clarifying not only these genera but also *Cyanotis, Belosynapsis, Pollia* and *Aclisia.*

Nomenclature of all species has been verified : *Commelina longifolia* Lamk. is the valid name for *C. salicifolia* Roxb. *Commelina galabra* (Wt., 1853) Cl., a later to homonym to *C. glabra* Meyer (1818), *C. persicariaefolia* Wt. ex. Cl. (1881), a later homonym to *C. persicariaefolia* DC. (1816) are *nomen nuda* and new names for these are to be given after scrutinising the new species of Blatter, Fischer, Barnes and Kumar described after 1920. *Aneilema ovatum* Wall. ex Cl. is a *nomen illegitimum* and a new name is necessary. *Murdannia blumei* (Hassk. 1870) Rolla *nov. comb.* is the valid name for *Aneilema hamiltonianum* Wall ex Cl. (1881). *Belosynapsis ciliata* (Bl. 1823) Rolla *nov. comb.* is the valid name for *Belosynapsis capitata* (Bl. 1827) Sprague and Fischer. The name *Pollia aclisia* Hassk. based on type species of another genus becomes a *nomen nudum* and hence *Pollia hasskarlii* Rolla *nom. nov.* is given.

Nomenclatural points of other species, new records of distribution and notes on doubtful species are added to the paper.

130. Studies on the Indian Flora (Eastern India) : 1. Observations on the vegetation of the Kameng Frontier Division, N.E.F.A.

ROLLA SESHAGIRI RAO and G. PANIGRAHI, Shillong.

A preliminary account on the vegetation of the area covered during the three Botanical explorations in the Kameng Frontier Division, stretching over a wide range of altitude from 300 m to 4667 m. and lying within 27°0-27°40′ N and 91°50′-92°25′ E is presented in this paper. The outer ranges of this Sub-Himalayan tract are of Tertiary origin with the inner ones of Gondwana Age. The soil is mainly rocky with a cover of clayey sand and mica sediment.

Climate of the outer ranges, from March to May is generally dry whereas along the higher altitudes it is usually dull, cloudy, foggy and cold with occasional showers. During October and November, the climate is comparatively drier but much colder along the whole tract.

Vegetation in the outer ranges up to Chakoo (2700 m.) is mixed evergreen type. The landscape consists of lofty mountains and deep gorges with thick impenetrable forests in which *Ficus, Acer, Quercus,* and *Schima* predominate. Beyond Peri La (3000 m.), the vegetation suddenly changes to narrow-leaved deciduous types mixed with Pine forest along slopes of Rupa valley (below 2000 m.) and is very sparse with different floral components such as ***Pinus excelsa, Quercus griffithii*** and ***Rhododendron arboreum*** etc., as members of an edaphic and biotic climax.

Beyond Bomdila (2750 m.), vegetation of different types viz., (a) the subtropical Pine-forest type (along Dirang Dzong valley, below 2000 m.) with almost similar main components as recorded in Rupa valley, (b) Wet Temperate Forest type with *Rhododendron-Pyrus-Rosa-Spiraea-Abies* association up to 4400 m. along the slopes approaching Se La and the valley from Se La to Jhang, (c) Stunted alpine moorland type along the slopes surrounding the Se La pass (4667 m.) and (d) the sub-alpine type along the slopes near Tibetan Border beyond Towang with many species similar to those of the Se La area, is successively met with.

As a result of the exploration tours in the area 2145 species belonging to 105 families with 1070 spp. of Dicotyledons, 15 families with 560 spp. of Monocotyledons, 20 species of Gymnosperms and 495 species of Cryptogams have been collected.

131. Studies on Indian Flora (Eastern India) : 2. Vegetational types along the Sal-forest belt of the Lower Brahmaputra Valley of Assam.

ROLLA SESHAGIRI RAO and G. PANIGRAHI, Shillong.

The vegetational types met with in the Darrang, Sibsagar, Nowgong, Kamrup and Goalpara Districts in the lower Brahmaputra Valley have been studied together with a collection of 1157 species from the reserve forests. The general vegetation is secondary and belongs to tropical deciduous forest type. The Sal (*Shorea robusta* Gaertn.) which forms extensive reserves in the area is principally associated with *Careya arborea, Altingia excelsa, Gmelina arborea, Dillenia pentagyna* and *Lagerstroemia flosreginae* etc. in varying combinations in these reserves.

The sal forest, however, passes imperceptibly into the mixed evergreen forest types in certain parts of the Charduar, Narduar and Chirang Reserves; into the grassland type in the foot hills of Mikir hills, Kaziranga and North Kamrup Reserves and into the riverian type along the banks of the Bhoreli-Dakroi and Sarlabhanga rivers.

The chief components of the mixed evergreen forests are *Phoebe hainesiana, Toona ciliata, Aquilaria agallocha, Tetrameles nudiflora, Lagerstroemia flosreginae* and *Duabanga sonneratioides* in the reserves in the area.

The grasslands are dominated by tall grasses like *Sclerostachya fusca, Saccharum spontaneum,* species of *Narenga, Themeda* and others together with a few species of *Salmalia, Dillenia, Phyllanthus, Careya* etc., the trees occurring particularly in the North Kamrup Reserve.

The riverian vegetation in the Bhoreli-Dakroi river banks are characterised by *Salmalia malabarica, Tetrameles nudiflora, Duabanga sonneratioides* with *Toddelia aculeata* as a common climber. Along Sarlabhanga river bank, *Acacia catechu* is predominant. Large number of rivers and streams in the area form swamps and Bheels which create and support the grassland and the riverian vegetation.

The vegetational types met with are different expressions of the Pro-climax stages which represent different phases of the biotic and edaphic climaxes in the valley.

132. Studies on the Indian Flora (Eastern India) : 3. A preliminary note on the vegetation of Keonjhar District, Orissa.

ROLLA SESHAGIRI RAO and G. PANIGRAHI, Shillong.

A preliminary account on the botanical tour undertaken in June-July, 1957 in the Reserve forests of Rebna, Atai and Gandhamardan Parbat in the Keonjhar district bordering upon Malyagiri in the west and Sukinda in the south and lying between 20°55′-21°40′ N and 85°15′-85°55′ E, is presented in this paper.

The greater part of these regions is hilly and belongs to lateritic formation consisting of gneiss, granite, haemitite and chromite schists almost without any soil cover in Gandhamardan and Meghanada ranges (C. 1000 m.), whereas, in the plains, soil is brown, sandy and porous, mixed with gravels borne down by many hill streams and rivers covering the area.

Climate is wet and warm, with 28°C. and 83% as the average maximum temperature and humidity, respectively, with many rainy days in this season.

Vegetation in parts of the Rebna Reserve forest bordering upon Meghanada Parbat to which Mooney (1950) refers in his Supplement as "virtually unknown and botanically unexplored", as also of the Gandhamardan reserve, approaches to tropical semi-evergreen type with *Callicarpa, Polyalthea, Ficus, Vitex, Flacourtia* together with tree ferns, *Alsophila, Cyathea* and the common woody climbers, *Gnetum ula, Bauhinia* etc., mixed with several deciduous species.

The remaining areas are characterised by moist tropical deciduous forests which are open and secondary in nature. The Sal (*Shorea robusta* Gaertn.) is the most dominant species in plain and flatter ridges of hills everywhere and is commonly associated with *Diospyros tomentosa, Careya arborea, Schleichera trijuga* and various species of *Terminalia* etc. among the trees, *Holarrhena antidysenterica,* species of *Ixora, Butea* and *Glochidion* etc. among the shrubs and *Smilax* and *Bauhinia* among the lianes and climbers together with a large number of parasitic and epiphytic species.

This exploration tour yielded about 600 species in which the 10 dominant families are Euphorbiaceae (40 spp.), Orchidaceae (35 spp.), Rubiaceae (33 spp.), Leguminosae (25 spp.), Apocynaceae (21 spp.), Cyperaceae (19 spp.), Gramineae (18 spp.), Liliaceae (16 spp.), Compositae (13 spp.), and Loranthaceae (9 spp.).

133. Studies in the vegetation of Gujarat Coast, Western India.

P. S. TOOR, Poona.

The coast-line of Gujarat extending from Daman to Cutch includes the deltoid regions of several rivers and four salt creeks viz., Hansthal, Bhavnagar, Sunarai, Bavliali and Dholera. In the present paper, studies were made in a plain country with an average elevation ranging from sea-level up to about 100 metres, round about Surat, Hajira, Dumas, Danti, Amruth Ankleshwar, Hansot, Aliobet, Broach, Dahej, Kavi, Cambay and Lunaj.

The habitat types included are waste places, river banks, dried ponds, and saline marshes along the sea coast. The soil is clayey or sandy and the areas are open to grazing, browsing, lopping, cutting, etc.

The vegetation of marshy land generally comprises *Avicennia alba,* Linn., *Sesuvium portulacastrum* Linn., *Sueda fruticosa* Forsk., and species of *Eleusine, Halopyrum, Bothriochloa* and *Aeluropus repens* Parl.

The common plants met with on the sandy beaches and sand dunes are *Cassia auriculata* Linn., *Launea nudicaulis* Hook., *Boerhaavia diffusa* Linn., *Evolvulus alsinoides* Linn., *Ipomoea biloba* Forsk., *Tridax procumbens* Linn., *Convolvulus arvensis* Linn., *Casuarina equisetifolia* Forsk., and *Phyla nodiflora* Linn. The last generally grows in depressions.

The salty flat land is generally colonized by *Sueda fruticosa* Forsk., *Cressa cretica* Linn., *Aeluropus repens* Parl., and sporadically growing *Avicennia alba* Linn., *Salvadora* species generally occupies the edges of this salty flat land.

Steep banks are rare. The general vegetation of these banks consists of *Capparis aphylla* Roth., *Balsamadendron mukul* Hook. f., *Lycium* species, *Cressa* *cretica* Linn., *Evolvulus alsinoides* Linn., and species of *Aristida, Cenchrus, Launea* and *Heylandia.*

Argemone mexicana Linn., *Datura stramonium* Linn., *Solanum xanthocarpum* S. & W., and *Cassia* species are invariably present in waste places but at some places e.g., at Broach, *Cryptostegia grandiflora* R. Br., *Kirganelia reticulata* (Poir) Bill., and *Jatropha gossypifolia* Linn. are also very common. Besides these plants, *Peristrophe bicalyculata* Retz., *Acacia arabica* Willd., *Calotropis procera* R. Br., *Cassia tora* Linn., *Leucas aspera* Spreng., *Alhagi maurorum* Desv., *Parkinsonia aculeata* Linn., *Achyranthes aspera* Linn., *Boerhaavia diffusa* Linn., *Cynodon dactylon* Pers., and species of *Amaranthus, Sporobolus,* etc. are the other plants met with in such situations. In Cambay, however, *Withania somnifera* Dunal, and *Jatropha gossypifolia* Linn., are very common near the outskirts of the town.

The hedges are mainly of *Euphorbia nerifolia* Linn. and *Euphorbia tirucalli* Linn.

Asteracantha longifolia Nees., *Amaranthus spinosus* Linn., *Ammania baccifera* Linn., *Phyla nodiflora* Linn., *Ipomoea aquatica* Forsk., and *Eclipta erecta* Linn., are common in moist situations. In some places, e.g. at Ankleshwar pure formation of *Bacopa monnieri* Penn., was met with in a dirty pool.

The vegetation of dried ponds and ditches consists mainly of *Asteracantha longifolia* Nees., *Mollugo lotoides* W. & A., *Polygonum plebium* Linn., *Coldenia procumbens* Linn., *Xanthium strumarium* Linn., *Eclipta erecta* Linn., *Capparis aphylla* Linn., *Ammania baccifera* Linn., *Heliotropium indicum* Linn., and species of *Bothriochloa, Eragrostis,* and *Cenchrus.*

Alhagi maurorum Desv., *Cynodon dactylon* Pers., *Sphaeranthus indicus* Linn., *Chrozophora tinctoria* A. Juss., *Argemone mexicana* Linn., *Zizyphus* species, *Calotropis procera* R. Br. *Launea nudicaulis* Hk f., *Xanthium strumarium* Linn., *Phyla nodiflora* Linn., *Verbascum coromandelianum* O.K., *Achyranthes aspera* Linn., *Boerhaavia diffusa,* Linn., and *Acacia arabica* Willd. are the common plants found growing in the uncultivated, dried beds of banks of rivers.

134. Vegetation of District Kaira, Bombay State.

P. S. TOOR, Poona.

Kaira District lies between 22°-23° latitude and 72·50-73° longitude and has an annual rainfall of 20″-30″. The climate is of extreme type with maximum summer temperature of 116°F and winter minimum temperature of 32°F. Most of the land is a flat plain and is under cultivation. Soil is of the Indo-Gangetic type known as Goradu

Solanum xanthocarpum Schr. & Wendl, *Argemone mexicana* Linn., *Cassia occidentalis* Linn., *Calotropis procera* R. Br., *Launea nudicaulis* Hk. f., *Cassia tora* Linn. are the common plants of waste places. Other plants of these situations are :—*Xanthium strumarium* Linn., *Datura stramonium* Linn., *Tribulus terrestris* Linn., *Gynandropsis gynandra* Brq., *Abutilon indicum* Sw., *Withania somnifera* Dunal,, *Euphorbia hirta* Linn., *Tridax procumbens* Linn., *Tephrosia purpurea* Pers., and *Gomphrena celsioides* Mart., the last one generally growing along foot-paths.

Euphorbia nerifolia Linn., and *Euphorbia tirucalli* Linn. are very common along hedges. *Kirganelia reticulata* (Poir) Baill, *Clerodendron phlomoides* Linn., *Pergularia daemia* Blatter & McCann, *Pergularia pallida* W. & A., *Balanites roxburghii* Planch, *Grewia populifolia* Vahl, *Mucuna prurita* Hook, *Streblus asper* Lour, *Cadaba indica* Lamk, *Capparis sepiaria* Linn., *Capparis spinosa* Linn., *Abrus precatorius* Linn., *Vitis trifolia* Linn., *Peristrophe bicalyculata* Nees, *Dioscoria bulbifera* Linn., *Gloriosa superba* Linn., *Achyranthes aspera* Cooke, *Pupalia lappacea* Moq, *Cissampelos pariera* Linn., *Tinospora cordifolia* Miers, *Clitoria ternates* Linn., *Cocculus hirsutus* Diels are the other plants met with in hedges.

Nelumbo nucifera Gaertn., *Trapa bispinosa* Roxb., *Ipomea aquatica* Forsk, *Typha angustata* Chaub & Bory, *Vallisneria spiralis* Linn., *Hydrilla verticillata* Presl., and species of *Lemna* and *Scirpus* are common aquatic plants.

Xanthium strumarium Linn., *Eclipta erecta* Linn., *Alternanthera sessilis* R. Br., *Amaranthus spinosis* Linn., *Cassia occidentalis* Linn., and *Martynia annua* Linn., grow in moist situations.

Eragrostis pilosa Beauv., *Eragrostis ciliaris* Lamk., *Cynodon dactylon* Pers., *Pennisetum cenchroides* Rich., and species of *Chloris, Cenchrus, Panicum, Digitaria, Echinochloa, Pennisetum, Setaria* and *Dacyloctenium* and some sedges are found growing in the uncultivated parts of the fields.

Weeds of cultivated fields and gardens include *Phyllanthus niruri* Linn., *Cyperus rotundus* Linn., *Spergula pentandra* Linn., *Digera arvensis* Forsk., *Zornia diphylla* Pers., *Cynodon dactylon* Pers., *Trichodesma indicus* R. Br., *Ruellia tuberosa* Linn., and species of *Panicum, Setaria* etc.

Cuscuta reflexa Rox., and species of *Loranthus* and *Orobanche* are the common parasitic angiosperms.

135. Ecology of grassland utilization in Saurashtra, Bombay State.

F. W. ALBERTSON, Rajkot.

Grasslands in Saurashtra are very extensive and form an important part of farm income. Most of the grasslands are badly overgrazed and as a result, are in very poor condition. Some better areas, however, are Government-reserved grasslands where grazing by livestock is not permitted during monsoon. Following the period of rainfall, however, hay is cut by hand sickles and stacked after which grazing is permitted until the beginning of the next monsoon.

Grasslands are generally on rough topography where rock is very common on soil surface. Valleys and ravines, however, usually have a fairly deep black soil.

Research indicates that on grasslands there is a good distribution of palatable high yielding grasses and forbs. However, where grazing has been year-long and heavy the good grasses have been largely replaced by unpalatable annual species. Decrease in number of species has also resulted in a decrease in density and yield of vegetation and an increase in sheet and gully erosion.

If the grasslands of Saurashtra are to be improved and brought somewhere to potential yield, it will be necessary to withdraw areas from grazing for several years in order to allow the process of secondary succession to again clothe the soil with the important perennial grasses.

136. On Dobera Glabra (Forsk) DC.

S. P. AGHARKAR, Poona.

Roxburgh in his Flora Indica Vol. I describes the above species as *Blackburnia monaldelpha,* which is a native of the mountainous parts of the Circars where it grows to be a tree with short axillary compound racemes, succeeded by fruits of the size and appearance of red cherries.

Clarke in Hooker's Flora of British India Vol. III gives Bombay as the locality and Geburne as the collector.

No material of the plant from the Circars is available in any Indian or European herbarium. The only Indian specimen of the species collected by Capt. Geburne from Bombay is available at Kew. All other material of the species available in the various European he[illegible]a is from Arabia (Yemen), Abyssinia and other parts of Africa.

There is a coloured drawing of the plant described by Roxburgh from the Circars in his Icones preserved at Sibpur which corresponds to the description given in his Flora. No succeeding botanist ,who has worked in this area, has been able to collect the plant. Eliott in his Flora Andhrica does not include it, Gamble does not mention it in his Flora of Madras but includes it in his "Indian Timbers" with the remark that he had not come across it in the Circars. Sri D. L. Sathe, who was conservator of forests in that area for several years, informs me that he never obtained it in any of the mountains of the area.

As regards the Bombay locality, Cooke in his Bombay Flora states "there is a small scrap of a flowering branch in the herbarium at Kew on which there is a ticket Capt. Geburne and this seems to be the only specimen obtained from India. Capt. Geburne was an ardent Horticulturist in Bombay itself and used to introduce plants from various places into his garden. No other botanist has found the plant in Bombay and the inference of its existence from the solitary specimen referred to seems to be hardly justifiable."

The specimen from the Circars is clearly different from the specimen collected from Bombay. While Roxburgh's plant from the Circars has alternate lanceolate leaves and grows to be a large erect timber tree, the specimen from Bombay has opposite ovate leaves and is a shrub. The Arabian and African material which was examined, corresponds to the Bombay material and is characterized by opposite leaves and shrubby habit. In his description of the genus Engler in his "Pflanzenwelt Afrikas" states that *Dobera glabra* is mostly a shrub.

As a Botanist of Roxburgh's standing is not likely to have described a species and prepared a coloured drawing of it without authentic material, it appears that Roxburgh's species, the wood of which was said to have been used for various purposes, must have become extinct in the area since Roxburgh's time.

A search for the plant by Rev. H. Santapau and his students in the Andhra area at my request last year was not successful It is possible that a more diligent search in the mountains of Coromandel may yet lead to its rediscovery.

PALAEO BOTANY

137. Ptilophyllum Gladiatum N. Sp. from Bansa, South Rewa Gondwana Basin.

M. N. BOSE and SUKH DEV, Lucknow.

Cuticular structure of a new species of *Ptilophyllum* (*P. gladiatum*) from Bansa, South Rewa, has been described.

Pinnae placed over the rachis, almost concealing it, obliquely placed, alternating, closely set or slightly imbricate towards the apical region; upper margin almost straight, lower slightly convex, apex acute; upper basal angle of pinnae rounded, lower basal angle less rounded, sometimes concealed by the pinna below. Lower cuticle of rachis with both stomata and papillae, epidermal cells slightly broader than the upper cuticle. Stomata present only on lower side. Cells of the upper cuticle usually rectangular, sinuously folded. Lower cuticle showing stomata forming bands between the veins and also a specialized marginal region with no stomata. Stomatal bands broader than vein bands; usually there is differentiation of stomatal and nonstomatal bands, but at places stomata may be seen over the vein region. The stomatal bands have 3-5 rows of stomata, mostly transversally orientated, not forming definite files but scattered in the stomatal bands. The cells over the veins 2-3 rows, more like marginal cells. Surface-wall of the cells of stomatal and vein region more commonly papillate. Guard-cells sunk, with well-developed curved crescent-shaped thickenings, subsidiary cells broad, [illegible]r walls looped, inner wall without papillae.

138. On the seeds of Viracarpon Hexaspermum Sahni, from the Inter-Trappean beds of Mohgoan Kalan.

S. D. CHITALEY, Nagpur.

Seeds of *Viracarpon hexaspermum* Sahni, a monocotyledonous, 6-angular, 6-locular, 6-seeded fruit, are recovered from fresh specimens of fruits collected from the Inter-trappean fossiliferous beds of Mohgaon Kalan, Chhindwara District, Madhya Pradesh, India. The seeds are complete in structure and have been isolated from the loculi of the fruits. About eighteen seeds have been collected and studied for their external structure. There is a gradual variation in their size, varying from 0·93×0·40 mm. to 3·58×1·72 mm. Individual seed is elongated, ovoid, erect, and slightly wider round and convex at the end which is directed towards the apex of the loculus and slightly narrower and flat at the end which is towards the base of the loculus. Each seed is angular and four sided with four longitudinal ridges to suit the four furrows of the loculus and it fills up the whole hollow of the loculus. Raphe is ventral, thick, and gradually broadened to the large spathulate cap like external scar of the chalaza, which extends to about one third of the length of the seed. The micropyle scar is seen at the lower end of the seed.

Further anatomical investigation of the seeds is being carried out by the author. The developmental stages of the different seeds will be of interest and may throw more light on the affinities of the *Viracarpon hexaspermum* fruit.

139. Ptilophyllum Sakrigaliensis n. sp. from Sakrigalighat, Rajmahal Hills, Bihar.

S. C. D. SAH, Lucknow.

A new species of *Ptilophyllum* from Sakrigalighat has been described in the present paper.

Frond incomplete; pinnae narrow, linear-lanceolate, separate and attached to the rachis by the whole width of their base; pinnae margins parallel and rarely forked.

Upper cuticle thinner than the lower; cells rectangular with lateral and end walls thin and sinuous; surface wall smooth. The lower cuticle shows no distinction between stomatiferous and non-stomatiferous bands; epidermal cells like those of the upper cuticle but here each cell with a single large papilla, nearly obscuring it; stomata sparse, sunken and irregularly distributed. Guard cells sickle-shaped and narrow; subsidiary cells small, cresentic, narrow and non-papillate.

140. On a new species of Coniferocaulon, C. Amarjolense n. sp., from the of Jurassic Rajmahal Hills, Bihar.

S. C. D. SAH, Lucknow.

The present paper describes the anatomical details of *Coniferocaulon amarjolense* n. sp., on the basis of which the affinities of the genus has been discussed.

C. amarjolense compares very closely to *Mesembrioxylon* Seward (1919; pp. 203-212) in having a small pith with scattered stone cells; sharply-marked growth rings; uniseriate, low medullary rays; scattered parenchym in the secondary wood; uniseriate or oppositely arranged biseriate pits and; in having 1-2 pits in the field with broad and somewhat inclined pores.

141. Jurassic Plant Microfossils from Sakrigalighat in the Rajmahal Hills, Bihar.

S. C. D. SAH, Lucknow.

The paper describes a rich microflora obtained by maceration from a carbonaceous shale collected recently from the lowermost intertrappean bed of Sakrigalighat in Rajmahal hills, Bihar. The microflora comprises more than 38 types of spores and pollen grains, a large number of fragments of wood and cuticular fragments. The spores and the pollen grains are described under the terminology suggested by Naumova (1937).

The Sakrigalighat microflora has been compared with these of Nipania, Andigama (Ceylon) and Salt-Range (Pakistan), and their stratigraphical significance has been discussed.

142. On a new species of Thinnfeldia Ett. from the Jurassic of the Rajmahal Hills, Bihar.

S. C. D. SAH & SUKH DEV, Lucknow.

In this paper a new species of *Thinnfeldia* Ett. is described from Chunakhal (25° 13′ 30″ N; 87° 29′ 52″ E), in the Rajmahal hills, Bihar.

Frond imparipinnate, incompletely preserved as impressions in a soft whitish-grey shale The pinnules are distantly spaced and are characterized by their ovate-elongate form, slightly decurrent base, somewhat pointed apex, and a straight mid-rib giving off numerous lateral veins which are forked more than once. The terminal pinnule is larger than the rest, broad near the base and gradually taper to a pointed apex.

143. A Fossil Dicotyledonous wood from Inter-trappean beds of Mahurzari.

L. J. SHALLOM, Nagpur.

A fossil decorticated dicotyledonous secondary wood has been described for the first time from the Deccan Inter-trappean beds of Mahurzari in Nagpur District.

From the anatomical study of the wood the following few characters are found to be important for its identification.

1. Vessels mostly solitary, placed at great distance from one another and diffusely arranged.
2. Parenchyma sparse and paratracheal.
3. Intervessel pitting hexagonal and closely crowded together.
4. Medullary rays multiseriate and heterogeneous, medullary cells large.
5. Fibers thin walled and septate with pits on radial walls.

Comparisons with living members of the families Datiscaceae, Anacardiaceae and Burseraceae are made since these families show much resemblance to the present wood. It has been found that the woods of Burseraceae show more characteristics common to the fossil wood.

144. A Preliminary Report on the Fossil Leaf Impressions from Mewar State.

(MRS.) T. K. TRIVEDI, Nagpur.

This paper gives a preliminary report of the fossil leaf impressions from Mewar State. The fossils have been collected from a fossiliferous locality near Udaipur. The age of the beds has been recorded as Tertiary. The morphological examination of the six specimens described in this paper shows that they belong to dicotyledenous plants. They are described in detail and also successfully tried for cuticular preparations.

Comparisons are being made with modern leaves for further identification.

SECTION OF ZOOLOGY AND ENTOMOLOGY

President :—Dr. P. Bhattacharya, M.Sc., Ph.D.

Abstracts

1. Orientation of oöcyst of Plasmodium gallinaceum in the stomach wall of Aedes aegypti.

T. N. GHOSH and H. N. RAY, Calcutta.

A study of the oöcysts of *P. gallinaceum* in the gut of *Aedes aegypti* was made in sections and in smear preparations. In several instances it was observed that, contrary to the usual belief, the oöcysts were intracellular in nature. The nucleolus of the infected host cell appeared as a vacuole and devoid of RNA suggesting that the host cell was on the verge of degeneration.

2. Further studies on the ciliate parasites (protozoa) of Bufo melanostictus Schneider; of Dharwar.

J. C. UTTANGI, Dharwar and G. T. TONAPI, Poona.

The hosts were collected chiefly from the surroundings of Dharwar and twelve ciliates have been described in detail from this host. Among the ciliates that are studied *Opalina coracoidea* Bezz., *Opalina ranarum* (Ehrenberg) Purk. & Val., *Cepedea* of the *dimidiate* type, *Nyctotherus cordiformis* (Ehrenberg) Stein, are the most common. Some ciliates like *Nyctotherus magnus* Bezz., *Cepedea longa* Bezz. *Balantidium helenae* Bezz. are added to the present list of ciliates known so far from this host. In addition a new species each of *Nyctotherus* and of *Cepedea* are described and recorded for the first time from this host. Some of the ciliates revealed certain morphological differences and these characteristic deviations from the typical form are treated mainly as changes due to host variations. Range of variation in each case has been given in a statistical form. It is of immense interest that the host, although had lived and developed in a locality where other frogs carried *Protoopalina* and *Zelleriella* yet showed no signs of such infections. This conspicuous absence of Binucleated Opalinids in this host indicates the significance of host-parasite relationship.

3. Excystation and substance regulation in Amoeba.

B. HAJRA, Calcutta.

The protoplasm of amoeba undergoes definite cytochemical changes if encysted for a long time. In newly formed cysts, upto ten days, cytochemical reactions for alkaline phosphatase, basophilia and feulgen remain highly positive. However, positive reactions of these substance-localisations seem to undergo remarkable changes with prolonged encystment. Four months old cysts become almost devoid of basophilic and feulgen reactions. However, alkaline phosphatase continues to present low positive reaction. Eight months old cysts ultimately become negative to alkaline phosphatase reaction. These cysts, weak in their cytochemical reaction, were employed for subculture to test their viability. Successful subcultures can be obtained from these cysts which are as old as eight months. These cysts, though low in their cytochemical reactions to alkaline phosphatase, basophilia and feulgen, are capable of converting into trophic forms when they show normal reactions for these substances. However, no subculture is possible from cysts which are more than a year old. The study raises two important issues : (i) The possibility of emergence of trophic forms from old cysts is independent of the intensity of three cytochemical reactions; and (ii) The possibility of immediate substance regulation in trophic forms.

4. The passage of inert particles through the Cell Surface.

SIVATOSH MOOKERJEE and B. GANGULY, Calcutta.

Studies are being made on the molecular dynamics of cell surface. Some experiments to study the inward entry of minute inert particles through the surface of living sponge cells have been done. When minute carbon particles are introduced into the culture media of freshly isolated sponge cells, almost immediately these particles find their way into the fold of the cytoplasm of the amoebocytes. These carbon particles undergo synchronised movement with the cytoplasm of the cell. There may be more than one such particle in a cell. Some cells may not at all take up such particles. In an event of pseudopodial thrust, it has been observed that the carbon particle may move ahead of the rest of the cytoplasm into the hyaline bulge. It is not yet known that the particles can pass out from the cell. From critical observations there seems to be a maximum limit of the size of such particles which can enter through the cell surface, below which all particles find an easy passage into the fold of the cell. Further experiments are being conducted to study the selective nature of the cell surface towards other inorganic particles. Particles of Silicon and Iron Oxide of similar size can also pass through the cell surface and enter the cytoplasm easily.

5. Protoplasmic reactions of living sponge cells exposed to different pH levels.

B. GANGULY, Calcutta.

Amoebocytes of fresh-water sponge are isolated and exposed to various pH levels. The protoplasmic behaviour of sponge cells show opposable tendencies at the two extreme pH levels. The increase of acidity (below pH 6·5) produces progressively blocking of the surface activity, increased vacuolation, shrinkage of the cell volume, and condensation of the granules into a single mass inside the cell. On the other hand, increased alkalinity (over pH 8·5) results in increase of surface activity, rapid movement of the internal granules, hypertrophy of the cell volume and the nucleus and increased permeability of the cell surface.

The phenomenon of recovery of cells from pH treatment and the rate of subsequent cell aggregation have been discussed.

6. Experimental determination of the zone of cell multiplication in regenerating Hydra.

S. N. NAGRAJAN, Calcutta.

Transverse cuts were made just above the plane of origin of the bud of hydras with single bud and allowed to regenerate. During the process of regeneration mitotic counts were made in the various planes to locate the zone of origin of cells. In such regenerating hydra the growth above the plane of cut is quite considerable. Mitotic figures of any good quantity were not found in any region.

7. Experimental studies on Hydra Regeneration.

S. N. NAGRAJAN and SIVATOSH MOOKERJEE, Calcutta.

The following five experiments were conducted to study the regeneration vis-a-vis organisation property of the material.

Expt. 1. Incomplete cuts in the middle of hydras were made and allowed to heal after 20—30 mins. Healing was total, and normal hydra resulted. If such cut ends of hydra were allowed to join after two hours it resulted in the appearance of a fresh row of tentacles at the plane of fusion.

Expt. 2. Joining hydra bits of different lengths in the same axis. If the lengths of bits were long a new row of tentacles formed at the plane of fusion.

Expt. 3. Hydras without manubrium of different lengths were joined by their cut ends. Two rows of tentacles resulted.

Expt. 4. Posterior ends being cut and then the pieces were united. Healing was complete and one or two basal discs were formed.

Expt. 5. Removal of the hypostomal region with tentacles resulted into two small hypostomes with tentacles.

8. Regulative nature of endoderm cells of Hydra.

SOMESH SANYAL, Calcutta.

The endoderm cells of hydra are highly basophilic in nature and they take part in the breaking down of proteinous material during the process of alimentation of food. Experiments were planned to study the nature of basophilic reaction of these cells under the stress of starvation. Fresh hydra was isolated and maintained without any food for weeks. The endoderm cells of a hydra undergoing fasting over a week tend to show the beginning of depletion of basophilic reaction in their cytoplasm. Further prolonged starvataion makes the endoderm cells vacuolated and results in the disappearance of basophilia from them. If hydra-food is once again introduced to the starved animal and the endoderm cells are observed after twenty-four hours, they show perfect regulation of rich basophilic concentration in their cytoplasm. The synthesis of basophilia in the process of metabolism is discussed.

9. Indeterminate cells in Hydra.

SIVATOSH MOOKERJEE, Calcutta.

The intricacy of the hydra organisation centres round two opposite tendencies, viz., the hypostomal and basal. A series of experiments were planned to study the effect of transplantation of the various regions of hydra on another hydra to follow their trend of differentiation. Grafting results show that the cells of the middle region are most indeterminate in their morphogenetic trends. The middle region cells from one hydra when grafted to the hypostomal region of another hydra are differentiated into a basal disc. However, the grafted cells of the middle region at the basal disc of another hydra behave entirely differently and form a hypostome. The experiments show the regulative nature of the middle region cells which behave differently at the hypostomal and basal regions. Straight isolation of middle region cells differentiate into miniature hydra. In different proportions, the middle region cells in isolation are mixed up with the anterior and posterior cells and the nature of such determination is followed. It seems that the factor of time in the process of determination is an important issue in these Morphogenetic events.

10. Description of Bipalium roonwali sp. nov., with notes on two other species of the family Bipaliidae from the Nilgiris, India.

G. RAMAKRISHNA and B. S. CHAUHAN, Calcutta.

The paper deals with a collection of land turbellarians made from different localities at Naduvattam in the Nilgiri Hills at an altitude of about 1981·2 meters (*Ca* 6,500 feet). It consists of *Bipalium flowcri* (v. Graff), *Bipalium proserpina* (Humbert) and *Bipalium roonwali* sp. nov. *B. proserpina* is recorded from some new localities and some additional observations have been made on its morphology, anatomy, etc. *B. flowcri* had been recorded so far from Ceylon. It is being recorded for the first time from India. The new species is characterised by its characteristic disposition of mouth and the genital openings, colour pattern of both the dorsal and ventral surfaces of the trunk; by the presence of a median longitudinal blue black streak which ends on the head lobe with a hammer shaped structure.

11. Cercaria shibi n. sp., a new furcocercous cercaria from Lymnaea acuminata.

S. C. DUTT, Izatnagar.

The paper describes a new apharyngeal brevifurcous ocellate distome cercaria with furcal finfolds obtained from *Lymnaea acuminata*. The cercaria gives the following measurements in microns : body length 240-270, mean 255; body width 75-105, mean 90; tail stem length 585-645, mean 606; tail stem width 45-60; mean 52; furcal length 232-270, mean 250. The intestinal caeca are fairly well developed and extend upto the level of the posterior border of the ventral sucker. The cercaria possesses nine pairs of penetration glands. A pair of 'escape glands' is present in unemerged cercariae. The flame cell formula is $2[3+2+(1)]=12$. Development takes place in tubular sporocysts.

The new cercaria resembles *Cercaria indica* XXXVI Sewell, 1922, in its general form but differs in the structure of the alimentary canal, number of penetration glands, number of flame cells and in the size of the body parts. It also resembles the cercariae of *Spirochis elephantis*, *Spirochis parvus* and *Vasotrema robustum*, but differs from them in the number of penetration glands.

12. On two new species of amphistome cercariae.

C. T. PETER, Izatnagar.

In addition to a number of amphistome cercariae previously reported from Bareilly, two more species have now been encountered in the local aquatic snails, both of which proved to be entirely different from the known forms. Of these two, the one obtained from *Indoplanorbis exustus* (Deshayes) more or less resembles *Cercariae indicae XXVI* Sewell, 1922, but markedly differs from it in the absence of any stellar pigmentation on the body cuticle and of any sphincter or swelling on the oesophagus and in the characteristic conical shape of the excretory cross-connection tending to form an anterior median diverticulum. The other new species discharged by *Bulimus pulchellus* (Benson), though bears a resemblance to *Cercaria bulimusi* Peter and Srivastava, 1955, is characterised by the presence of two lateral diverticula anteriorly on the main excretory vessels and of two median diverticula on the transverse connecting vessel and by the elongated nature of the oesophageal bulb.

13. Studies on the morphology of a microfilaria occuring in the blood of buffaloes in Bareilly.

C. T. PETER, Izatnagar.

Details of the studies made on the morphology of a species of microfilaria commonly encountered in the peripheral blood of buffaloes in Bareilly are presented in this paper.

The larva is sheathed, the sheath forming a short capsule-like extension proximally and a tape-like elongation distally. In blood smears stained by Giemsa's, the larva measures 207 by 8 microns and the sheath 321 microns in length, the distal extension of the sheath being 88 microns from the larval tail-tip. The different fixed points of the larva are at the following levels from the anterior end : nerve ring 39 microns, excretory pore 60 microns, excretory cell 67 microns, genital cell 110 microns and anal pore 149 microns. The larva exhibits two clear areas—an anterior viscus at the extreme anterior end and a larger central viscus about the middle of the body immediately anterior to the genital cell.

The microfilaria resembles in its general structural features that of *Setaria cervi* (Rud.) described by Williams (1955). Since a large proportion of the local buffaloes are known to harbour *S. cervi,* it is assumed that the larva under study is probably that of *S. cervi.*

13(a) On a new ovian trematode of the genus Cyclocoelum Brandes, 1892.

P. N. CHATTERJI, Cuttack.

There was much controversy regarding the validity of different sub-families of the family *Cyclocoelidae* Kossack, 1911. In this paper I have considered *Cyclocoelinae* Stossich, 1902 to be the only valid sub-family.

Similarly there was much controversy regarding the validity of different genera known in the sub-family *Cyclocoelinae.* I have discussed in this paper the validity of only two genera viz., *Cyclocoelum* Brandes, 1892 and *Typhlocoelum* Stossich, 1902 and with a slight modification of Morishita's (1924) view I have divided each of the two valid genera into three distinct groups :

Group I—Where ovary is distinctly pretesticular.
Group II—Where ovary is distinctly inbetween the testes.
Group III—Where ovary is distinctly post testicular.

Each of the above three groups have been further subdivided into two sub-groups :

Sub-group A.—Three gonads are arranged in such a way that they form three points of a triangle.
Sub-group B.—Three gonads are arranged in such a way that they are in one straight line.

Further, I have described in this paper a new species of the genus *Cyclocoeum* which comes under the group where ovary is pretesticular and the sub-group where the three gonads form three points of a triangle. I have also discussed the validity of the new species.

14. Nephridial system of the land leech Haemadipsa zeylanica agilis (Moore).

S. S. BORA and M. L. BHATIA, Delhi.

General plan of the nephridia in land leeches is the same as in *Hirudo, Hirudinaria, Haemopis* described by Bhatia. Seventeen pairs of nephridia are placed from segments sixth to twentysecond.

A typical nephridium of *Haemodipsa* however differs from those of *Hirudinaria* and *Haemopis* in shape and size of the main lobe, the length of the vesicle duct and also the length of the duct leading from vescile to the nephridiopore. The shape and size of the main lobe vary slightly in the nephridia of different regions.

The nephridial vesicles in *Haemodipsa* are comparatively large in size and are therefore capable of storing more of the excretory fluid. The nephridiopores open on the lateral sides of the body, and the excretory fluid serves an additional function of moistening the skin. Last pair of nephridiopores open into the grove between the body and the posterior sucker. The openings are situated below the fleshy lobes of the auricles on both sides of the body. The excretory fluid from these nephridiopores moistens and lubricates the groove where the body and the posterior sucker join and it facilitates the free movement of the body when the posterior sucker is fixed on to the substratum.

Compact integument, the lateral openings of the nephridiopores, the special location of the last pair of nephridia, the moistening of the body by the excretory fluid and acute receptors are some of the features that are special adaptations to the terrestrial mode of life in the land leeches.

15. Investigations on the control of land leeches in Kumaon.

B. D. BHATT and M. L. BHATIA, Delhi.

In Kumaon Hills two species of land leeches are commonly found, *Haemadipsa zeylanica agilis* (Moore) and *Haemadipsa montana* (Moore). The former occurs in great abundance and has a very wide range of distribution. The land leeches are a source of great trouble to human beings and are a great menace to the domestic animals.

Two methods to control the leeches are planned, viz. :—(1) Killing them by spraying chemicals in the infested areas, (2) By using leech repellents. Nicotine was found to be an excellent chemical in killing leeches. Common salt, copper sulphate and lime sprays have also been found very effective.

Since spraying on large scale in the vast leech infested areas has not been found practicable, search for a suitable leech repellent was made. Various alkaloids, phenols and their derivatives, oils and some other substances were tested in the laboratory and in the field for their leech repellent reactions. Substances tested according to their effectiveness are aranged under the following categories :— excellent, good, tolerably good, mild, and very mild. Excellent repellents : Nicotene, phenol, resorcinol, thymol, beta nephthol, picric acid, glycerol, dimethyl phthalate and sodium chloride.

Good repellents : Lemon grass oil, creosote, clove oil, copper sulphate, between 80 and juice extract of inflorescence of *Cannabis sativa*, a wild plant in Kumaon.

Tolerably good repellents : Pyrogallol and mustard oil.

Mild repellents : Citronella oil, vanillin and liquid paraffin.

Very mild repellents : Magnesium sulphate, menthol and carbon tetrachloride.

Benzyle benzoate, and ingredient of a formula reported by Audy and Harrison (1954) as an effective leech repellent has not been found to possess power to repel *Haemadipsa zeylanica agilis*. Zinc oxide used by Harrison, Audy and Traub (1954) as a leech repellent ointment also does not prove as an effective repellent in the case of *Haemadipsa zeylanica agilis*.

16. On the gross anatomy of a Bonellid from the Indian Sea.

K. V. JOSE, Delhi.

Bonellids are rare forms, and none have so far been recorded from the Indian Sea. In a zoological survey of the region of Coral belt of Pirotan, and island in the Gulf of Kutch, it has been possible to collect this echiuroid in fairly large number. It has been identified by the British Natural History Museum as *Ikedella misakiensis* (Ikeda) and a short note on its occurrence has already been published by the author. A detailed examination reveals that the worm resembles in all respects the genus *Acanthobonellia* and not to *Ikedella*. One of the generic characters of *Acanthobonellia* is the presence of very minute setae on the ventral side of the body below the mouth, while the genus *Ikedella* is characterised by the absence of any such setae. In the Indian bonellid the setae which never exceed 15 in number are all seated in a single muscular cushion situated on one side of the ventral nerve cord. It differs from the only other described species of the genus *Acanthobonellia* in which the setae exceed 27, and are situated on two cushions which are placed on their sides of the nerve cord below the mouth. The circulatory system in this form differs from all other bonellids in that, the heart encircles a good portion of the long tubular stomach.

Sexual dimorphism in bonellids is well known. The males of this bonellid are the largest of all the bonellian males recorded so far, and they reach up to a length of 5·2 cms. They remain as a parasite usually inside the solitary nephridium of the female. One important difference in the body-wall of the male is that there is no trabecular layer as is described in the related males.

17. The pace-maker mechanism and the re-filling of the auricle in the heart of Achatina fulica.

K. C. GHOSE, Calcutta.

The heart and the pericardial chamber of *Achatina* are like those of the majority of the gastropodes. The pericardial cavity is a closed sac except the narrow pulmo-pericardial aperture, which communicates it with the pulmonary sinus. The auricle is connected with the pulmonary sinus and the ventricle at its opposite ends.

The myacardium of both the auricle and the ventricle consists of non-striated, branched muscle fibres. Bundles of fibres resembling those of the myocardium run from auricle to ventricle and form a bridge between the two. Considerable amount of areolar tissue is present among the auriculo-ventricular bundles. The fibres of auriculo-ventricular bundle unite with the fibres of the myocardium in both the auricle and the ventricle. The auricular systole is followed by the ventricular systole and the two do not overlap. The impulse of contraction which arises at the tip of the auricle, passes to the ventricle through the auriculo-ventricular bundles. The regularity in heart-beat is maintained by the latter.

The re-filling of the auricle is not a passive one as has been previously described. The supposed hydrodynamic condition which has been considered to be responsible for the re-filling of the auricle disappears completely with the removal of the pericardium, but the heart continues to beat rhythmically even after that. The cessation of heart-beat several hours after the removal of the pericardium is really due to the loss of blood.

18. Histology of the heart and pericardium of Achatina fulica.

KRISHNA CHANDRA GHOSE, Calcutta.

The heart of Achatina is a powerful structure and can drive the blood with a considerable force.

The pericardium is tough and double-walled and both the parietal and visceral layers are bound externally by a single layer of flat cells with prominent nuclei. The inner faces of the layers are devoid of any epithelia and they are formed by a thin sheet of tissue consisting of longitudinal muscle fibres. Such tissues form the inner lining of the epithelia also. The space between these two sheets is occupied by branching muscle fibres, which are interwoven and fused with one another.

The walls of both the auricle and the ventricle are made of myocardium. Externally, the myocardium is bound by a thin epicardium with very large nuclei, which give it a beaded appearance. The endocardium is absent. The myocardium is formed by a network of closely packed, branched, non-striated muscle fibres running in various directions and uniting with the neighbouring branches. A distinct sarcolemma is present. The nucleus is large, oval and centrally placed. The auriculo-ventricular valves are formed by the inpushing of the ventricular wall. The wall of the ventricle is thicker than that of the auricle.

19. The excretory system of Achatina fulica.

KRISHNA CHANDRA GHOSE, Calcutta.

The excretory system of gastropods exhibits remarkable .modifications in co-relation with their habits. The large lumen of the kidney of *Achatina* is filled up with blood, which is partly stationary, and the whole of it does not pass to the general circulation at a time. The movement of this amount of blood is controlled by systole and disastole of the ventricle and also by the movement of the powerful cilia lining the reno-pericardial passage. The body of the kidney consists of narrow, closely packed tubules made up of a single layer of polyhedral or squarish or wedge-shaped cells, the separating cell membranes of which are not differentiated in most cases, forming a syncitum. Structures, identical with the Malpighian corpuscles are present in large numbers only in the posterior wall. The corpuscles are with or without sub-capsular spaces and the capsule is either made of tubules or fibrous in nature. Considerable amount of urine in a very dilute state is retained in the large pelvis and the space within the ureter, which help to keep the mantle moist. The long ureter opens in the pulmonary aperture and the urine is discharged directly to the exterior, thereby preventing pollution of the mantle cavity.

20. Effect of Ribonuclease on the uptake of $Ca^{45}C_{12}$ by the mantle edge of Anodonta cygnaea.

K. K. NAIR, Bombay.

The mantle edge of bivalves is an area rich in RNA. Several authors have studied the different aspects of the metabolism of the mantle edge and the mantle interior and have found that the mantle edge is a region which is more active than the mantle interior. The uptake of $Ca^{45}c12$ by the mantle edge of *Anodonta cygnaea* in the presence and absence of Anase was determined from the total specific activity of the pieces of the mantle edge using a Geiger Muller counter and also by the method of autoradiography. The results show that there is a decrease in the uptake of $Ca^{45}c12$ in the presence of Anase. It is possible that the RNA present in the cell surface is instrumental in the uptake of Ca ions. Ribonuclease probably interferes with the ability of the cell surface to bind new calcium ions.

21. On Occurrence of Synidotea variegata in Karwar and Synidotea worliensis (sp. nov.) in Bombay.

U. N. JOSHI and D. V. BAL, Bombay.

Two species viz. *Synidotea Variegata* and *Synidotea worliensis* (sp. nov.) of Isopods belonging to the family *Idoteidae* of the Sub-order Valvifera have been recorded from Karwar and Bombay respectively. In spite of their apparent similarity with each other, the Bombay specimens are placed under a new species in view of their significant and distinct morphological differences, like duplication of spines on the outer lobe of first maxilla and small, oval outer lobe of the second maxilla as against single set of spines of the first maxilla and elongated outer lobe of the second maxilla in *Synidotea variegata* Colleg.

22. Neurosecretion in Squilla holoschista.

RUBY DANIEL, Madras.

Examination of the stained serial sections of the brain, connective ganglia, thoracic and abdominal ganglia of *Squilla holoschista* showed the presence of four types of neurosecretory cells. The first type of cells located in the brain and in the last abdominal ganglia are 30-40/μ and 80-120/μ, in diameter respectively. The cytoplasm of these cells is stained intensely with acid-fuchsin while the nuclei are deeply stained with aniline-blue. On the contrary in the second type of cells the cytoplasm is stained with aniline-blue and the nuclei are stained with acid-fuchsin. In both these types there are no vacuoles and large secretory droplets. The third type is characterised by a large (100-130/μ in diameter) irregular cell-body, large flat to round nuclei with 1-2 nucleoli, granulated cytoplasm and numerous small oval-shaped vacuoles in the whole cytoplasm or very large peripherally situated vacuoles. This type is found in the connective ganglia, thoracic and abdominal ganglia. The fourth type of cells are located in all the neurosecretory cell-groups of the nervous system. These are small (10-15/μ in diameter) and possess very little cytoplasm which at certain times shows secretory activity. These four types are compared with those described in the Decapoda.

23. Certain observations on the ecology of Artemia salina.

DAYA KRISHNA and INDERCHAND BAID, Jodhpur.

In the State of Rajasthan *Artemia salina* is found only in the saline water of the Sambhar lake. It is the permanent inhabitant of the lake and lives there from 3·5° Be to 8° Be and in pans upto 23° Be. The range of tolerance to salinity is very wide. It dies in Summer as the brine approaches saturation due to increase in carbonates, bicarbonates, carbondioxide contents, evaporation of water and decrease in the amount of dissolved oxygen.

The little brine shrimps are abundantly distributed throughout the lake but their clouds and streaks are generally found near the shore. The great density of their aggregation seems to be the result of local currents. Their distribution in the lake is determined by four factors :—

(1) salinity of the brine,
(2) amount of carbonates and bicarbonates in the brine,
(3) amount of dissolved oxygen in the brine,
(4) amount of carbondioxide in the brine.

The natural population of *Artemia* is highly affected by the environmental factors. Thus the rate of mortality depends upon the physical and chemical properties of the lake water in different seasons, temperature and natural and artificial water currents. It was found that the most favourable period for the growth of population was in between the minimum tolerance and maximum tolerance of the environmental factors. Before dying, they deposit immense layers of eggs, in some places over an inch in thickness. The eggs are hard shelled. They often float on the surface in long interlacing streaks. This species is well adapted to such an unfavourable environment.

24. "Taxonomic Studies on the Indian Membracidae."

M. G. RAMDAS MENON and J. N. DAS, New Delhi.

The authors, while carrying out a survey of the membracid fauna of Delhi, came across with four new species belonging to the genera *Tricentrus*, *Leptocentrus* and *Otinotus* which are named as follows: *Tricentrus linearis*, sp. nov. (on lucerne), *Leptocentrus aeglevorous*, sp. n. (on *Aegle marmelos*) and *L. narayani*, sp. n. (on *Zizyphus* sp.) and *Otinotus tamarixus*, sp. n. (on *Tamarix gallica*). In addition to these, thirteen species of membracids already known from elsewhere in the Indian union and belonging to Genera *Oxyrhacis*, *Tricentrus*, *Leptocentrus*, *Otinotus*, *Coccosterphus* and *Gargara* are recorded for the first time in Delhi.

A species procured from Coimbatore on *Cestrum diurnum* also proved to be an unrecorded one which is named *Leptocentrus coimbatorensis*, sp.n.

Studies on the membracids in the National Pusa Collection of I.A.R.I., New Delhi, revealed that two species recorded from India under the names *Anchon pilosum* and *A. rectangulatum* cannot be assigned to that genus on account of the presence of four apical cells in the hind wing and hence these are transferred to a new genus *Anchonomorpha* gen. n. which comes under the tribe Leptocentrini.

25. 'Taxonomic studies on the Indian Aphididae. I. Additions to the aphid fauna of Delhi.'

M. G. RAMDAS MENON, and J. G. PAWAR, New Delhi.

Ghulam Ullah (1940) published a paper on the aphid fauna of Delhi in which he recorded seventeen species from different host plants. The absence of any further aphid records from this part of India prompted the present authors to make an intensive survey and they have been able to procure as many as twenty-eight species of aphids within a short period of nine months from both cultivated and non-cultivated plants, out of which fifteen are additions to the known aphid fauna of Delhi. It is interesting to note that this collection contained a genus hitherto unrecorded from the world and which the authors have named *Ceratopemphigiella*, gen. nov. with *Ceratopemphigiella delhieinsis*, sp. nov. as its type. This genus is closely related to *Ceratopemphigus* Schouteden and *Prociphilus* Koch, but differing from both these in having the antennal sensoria limited to the third and fourth segments only. Another interesting record is *Brachyunguis calotropicus*, sp. nov. found breeding in the flower-heads of *Calotropis* sp., an aphid differing from all the other recorded species of the genus in the absence of any sclerotised patches on the body. *Saltusaphis africana* Eastop (1955), a very recently described species from East Africa, has also been recorded from Delhi, which appears to be the second record of the species from the world. A full paper dealing with the description of these species will be published elsewhere.

26. "A new species of Metacanthus (Hemiptera-neididae) from Delhi together with a key for the Neidid Genera of the Indian region."

RAMDAS MENON and SWARAJ GHAI, New Delhi.

The authors, while collecting different insects from the Estate of the Indian Agricultural Research Institute, New Delhi, came across a new species of neidid breeding on the growing tips of the bottlegourd plants. This is named *Metacanthus delhiensis*, sp. nov. and described. This species differs from the only other known Indian species of the genus, *Metacanthus pulchellus* (Dallas), by the slightly larger size, uniformly light ochraceous body colour without any dark rings on the appendages, only the apical fourth of the antennal club being white, the longer head and pronotum, the latter also less elevated with the tubercles to the posterior not so prominent, the hemi-elytra being longer and narrower, with three distinct cells on the corium and the clavus of the hindwing only slightly emarginate.

A key for the separation of the eight neidid genera at present recorded from the Indian region is also given.

27. Mallophagan parasites from Indian birds. Part V. Species belonging to the genus Ibidoecus Cummings, 1916 (Ischnocera).

B. K. TANDON, Lucknow.

Four species of *Ibidoecus* Cummings, 1916 occurring on Indian Ibises have been reported. Of these *I. dennelli* sp. n. from *Pseudibis papillosus* (Temminck & Laugier) has been described in full and the remaining three, *I. clausus* (Giebel), 1874, *I. bisignatus* (Nitzsch), 1866, and *I. plataleae* (Denny), 1842, from *Threskiornis melanocephala* (Latham), *Plegadis f. falcinellus* (Linn.) and *Platalea leucorodia* Linn. respectively have been redescribed. The species *I. robustus* created by qadri on the basis of a single female straggler, collected from an unidentified water bird, could not be identified and has been made a synonym of *I. clausus*.

Some remarks on differences between *I. plataleae*, a parasite of spoonbill (subfamily Plataleinae), and the remaining species, all from ibises (subfamily Plegadinae), are included. A key to the species has been devised.

28. Some interesting features of the life-history and larval anatomy of an Encyrtid-parasite of Coccid.

S. MASHHOOD ALAM, Aligarh.

Thomsonisca brittanica sp. n. is an endoparasite of *Chionaspis salicis* Lin. on *Tilia sp.* The same host-coccid has *Aphytis diaspidis* How., as its ectoparasite. The two parasites form good example of multiparasitism not fatal to either species. Neither superparasitism nor hyperparasitism is ever recorded. Never more than one egg is laid in a single host. Egg stage is followed by three larval stages and a pupal stage with naked pupa. Parasite has only one generation in a year with stable host-parasite relationship which makes it a successful parasite.

Larva is devoid of any external membranous envelope—a feature contrary to present writer's own observations on other Chalcid-parasites. Larva is apodous and its anatomy deals with the external, as well, as internal structures. The internal organs are well developed.

29. A Comparative study of digestive system of Heirodula sp. (Mantidae) and Holochlora sp. (Tettigonidae).

S. V. RAJAN, Coorg.

The present paper is a part of a series of investigations comprising the comparative study of the anatomy, histology, and physiology of digestive system of insects, with particular reference to their food habits, peritrophic membrane and Malpighian tubules.

Heirodula sp. (Mantidae) and *Holochlora* sp. (Tettigonidae) have been studied as an example of carnivorous (predatory) and phytophagus insects respectively.

A long and extensive foregut with a capacious crop, rudimentary gizzard, a short mesenteron, and hindgut with well developed salivary glands and enteric caecae, of *Heirodula* sp. is anatomically well adapted for a highly nutritious carnivorous diet; and a large saclike crop, a well developed muscular gizzard, with pronounced denticles for mastication and straining, and a longer mesenteron of Holochlora sp. is well adapted structurally for a less nutritious vegetarian diet. These findings are in agreement with that of Bordas and Bryantseva and others.

Comparative histology and histo-chemical study of the digestive system of the above two insects species are under investigation.

30. Digestive system of Gryllotalpa africana Beauvois (Orthoptera : Insecta).

R. RAKSHPAL, Lucknow.

The digestive system consists of the stomodaeum, mesenteron, and the proctodaeum. The stomodaeum is distinguishable into a pharynx; and an oesophagus whose one side forms the crop. The posterior region is modified to form the proventriculus and the posterior end forms the cardiac valve. The mesenteron has a pair of gastric caeca and two pairs of dichotomously branched gland-like structures at the anterior end. The proctodaeum is differentiated into ileum, colon and rectum. There is a pair of large anal glands.

31. Studies on the digestive organs of Ranatra elongata Fabr. (Nepidae) and Sphaerodema rusticum Fabr. (Belostomatidae). (Hemiptera : Heteroptera). Part I. Morphology of the Digestive organs.

S. C. RASTOGI, Pilani.

The alimentary canal of *Ranatra elongata* Fabr. is a long, coiled tube and is divisible into three parts; the foregut, the midgut and the hindgut. The foregut consists of a sucking pump and a narrow oesophagus. The midgut or the ventriculus is the longest convoluted tube and unlike other Heteroptera can be differentiated into three distinct regions; the 1st ventriculus, the 2nd ventriculus and the 3rd ventriculus. The wall of the 1st ventriculus is thick and contains vacuolated cells. The hindgut consists of a thin walled rectal sac and a narrow tubular rectum. Two pairs of malpighian tubes open at the junction of the midgut and the hindgut. The salivary glands consist of a pair of principal and a pair of accessory glands. The principal gland is bilobed and aciniform while the accessory gland is tubular. The salivary ducts open separately.

The digestive organs of *Sphaerodema rusticum* Fabr. are similar to *Ranatra elongata* except that the midgut is differentiated into four distinct regions. The 1st ventriculus is a wide sac, the 3rd ventriculus is also a wide but short chamber, while the 2nd and 4th ventriculus are tubular.

32. A note on the Tentorium of Idiocerus atkinsoni Leth. (Homoptera, Jassidae).

G. L. ARORA and SAWAI SINGH, Hoshiarpur.

A confusion prevails regarding the homologies of the Jassid tentorium because very little attention has been paid to the muscles that arise from its parts. The tentorium in *Idiocerus atkinsoni* consists of the anterior, the dorsal and the posterior tentorial arms. The anterior tentorial pits lie quite far back near the bases of the antennae and the anterior tentorial arms are small struts which do not meet the transverse tentorial bar. The dorsal tentorial arms are stout bars, arising from the bases of the anterior tentorial arms and extending towards the ocelli where they are firmly united with the inner surface of the cranium. The posterior tentorial pits are shifted inward to the distal ends of the hypopharyngeal apodemes and the posterior tentorial arms which are intimately fused with the latter proximally run inward to meet and form the transverse tentorial bar across the occipital foramen; this condition presumably gives the necessary support to the transverse tentorial bar in the absence of any support from the anterior tentorial arms and helps in bearing the stress and strain of the dilator muscles of the pharynx and the retractor muscles of the labium which arise from its outer ends.

The tentorium of *Idiocerus atkinsoni* thus is modified from the primitive condition of the homopteron tentorium to meet the structural changes in the insect head, following a line of evolution leading to specialization.

33. The external morphology of the abdomen of the common earwig of Naini Tal.

H. S. CHAUDHRY and R. K. BHARDWAJ, Naini Tal.

A study of the external morphology of the abdomen of the common earwig of Naini Tal, *Labidura riparia inermis*, reveal a number of interesting features not reported hitherto. The abdomen consists of 11 segments, the VIII and IX segments in the female are telescopic. The last segment is represented by a narrow pygidium. The pleurites are absent in the adult and the tergites and sternites together form a complete tube-like covering of the abdomen. The tergal and sternal plates, like those in *Forficula* (Henson, 1953), are compound structures. They are formed by the fusion of the acrotergites and acrosternites at their anterior margins where internal-antecostal ridges and antecostal sutures are developed exhibiting secondary segmentation. The first sternum seem to be wanting. The first tergum is, however, simple as the acrotergite between it and the metanotum does not fuse with it but the thoracic exoskeleton.

The two sexes in *Labidura* show several well marked differences. In the male the two forceps are straight with contiguous bases and provided with 3-5 teeth towards the inner side near the base. While in the male the forceps are stronger, somewhat curved with remote bases and may bear 2 teeth in the middle region.

34. "Morphological studies of wing and wing-venation of three Indian Membracid Species."

UPENDRA CHANDRA PANDA, Cuttack.

The morphology of the wings of three Indian membracid species, *Otinotus oneratus*, *Leptocentrus taurus* and *Oxyrhachis tarandus*, belonging to two subfamilies, has been studied with special reference to the wing venation. The principal wing veins are characterised as follows:

1. C or C+Sc forms the anterior thickened margin of the membracid wing.

2. R_1 appears as a cross vein joining Sc and R_s; R_{2+3} and R_{4+5} are always distinctly seen. In the fore wing they are joined by a cross vein r, which is absent in the hind wing.

3. M_{1+2} and $M_{3\ 4}$ are the two factors into which M divides and these are joined by a cross vein m in the fore wing but not in the hind wing. M_{1+2} coalesces with R_{4+5}, thus obliterating the cell R_4 in the fore wings but not in the hind wing, except in *Oxyrhachis*.

4. The vein Cu in the fore wing divides into Cu_1 and Cu_2—which is not the case in the American species. These factors remain unseparated in the hind wings.

A cross vein m-cu joins M_{3+4} with Cu_1 in the fore wing and M_{3+4} with Cu in the hind wing.

5. The 1st A is distinct and has a convexity in the fore wing at its base. The 2nd and 3rd A remain distinct in the fore wing (unlike the case in the American species) but coalesce for a variable length in the hind wing.

35. Aberrant forms of spermathecae in Culicoides alatus Das Gupta & Ghosh (Ceratopogonidae : Diptera).

S. K. DASGUPTA and P. SEN, Calcutta.

Details of spermathecae of a large number of wild caught *Culicoides alatus* were examined in Calcutta and variations noted. The usual condition in the species is to possess three spermathecae, two of almost equal size and the other rudimentary, the measurement being 0·07 × 0·06, 0·06 × 0·05 and 0·03 × 0·01 respectively. The rudimentary supermathecae however showed considerable variation in size and shape and in extreme condition it assumed almost the same size measuring 0·06 × 0·05. This last condition is noticed only in about 1 per cent of the specimens. Such semiequal three spermathecal condition is found only in primitive Culicoides as in *C. anophelis*. This variation may reflect on the phylogeny of the character within the genus.

36. On the respiratory system of Platypleura octoguttata Fabr.

G. T. TONAPI, Poona.

The present investigation involves a morphological study of the respiratory system together with the mechanism of respiration described and illustrated. The number, position, anatomy and probable closing mechanism of the spiracles are described. Each spiracle is provided with a single occlusor muscle without any dilator. The cephalic respiratory system consists of three large airsacs. The thoracic respiratory system consists of six large airsacs and a pair of tracheal trunks. The abdominal airsac when dilated extends posteriorly as far as fourth or fifth segment. The lateral abdominal tracheal, the dorsal and ventral commissures or anastomoses are conspicuously absent. The rate and amplitude of breathing movements are recorded. Experiments were conducted to understand functional specialisation of the spiracles, if any. Some of the probable directions of the air currents in the body of the insect under study are pointed out.

37. A comparative study of spiracular structure and mechanisms in some Hymenoptera.

G. T. TONAPI, Poona.

An exhaustive and fully illustrated account of comparative morphology and mechanisms of the spiracles of 75 species of adult Hymenoptera is given. A consistent terminology is developed and the major taxonomic groups are characterised in terms of their spiracular structures. Two main types of closing mechanism namely (i) External and (ii) Internal are recognized in Hymenoptera. Although both these types occur in the thoracic spiracles the latter is the only one found in the abdominal region. A classification of closing mechanism is proposed. The external closing type includes 4 kinds respectively possessing (a) lids, (b) pronotal occlusor sclerite, (c) an operculum and (d) membranous flaps. The internal closing type includes three kinds possessing either (a) callipers, (b) lever-actuated flap-valve or (c) lever compression of atrio-tracheal junction. An atrium always occurs in this type. The distribution of these types in Hymenoptera is described and the classification applied tentatively to some other insect orders. The spiracles may also be classified according to the shape of their muscles. Three types are recognised, (i) an acicular occlusor type which occurs always in the first thoracic spiracle, (ii) a fan shaped occlusor type consistently occurring in the 2nd thoracic and finally, (iii) a cylindrical or parallel type found in the abdominal spiracles. Some apparent phylogenetic implications based on the morphological characters of the spiracles are pointed out. An interesting correlation seems to exist between the thickness of cuticle in which the spiracles are set and the development of atria with tracheal aperture below the general integument. Any interpretations in terms of water conservation would be quite speculative at this stage.

38. A Comparative study of the respiratory system of some Hymenoptera.

G. T. TONAPI, Poona.

Detailed accounts and illustrations of the tracheal system of 50 species representing all major taxonomic groups are provided. The basic elements of the Hymenopteran tracheal system are described, with special emphasis on *Xyela*, and some of their homologies elucidated. Modifications of the basic pattern occur mainly through two evolutionary processes, (a) loss or reduction of metamerism consequent upon the loss of spiracles and (b) obliteration or modification of basic elements through transformation of tracheae into air sacs. Loss of metamerism correlated with loss of spiracles enables one to recognise five main types of tracheal system, here referred to as (1) Complete, with 10 pairs of spiracles and relatively primitive metamerism, (2) Bethyloid and (3) Evanioid, with gastral reduction and modification, (4) Proctotrupoid, with loss of gastral spiracles and (5) Chalcidoid with reduction of thoracic and gastral spiracles. Airsacs undergo hypertrophy and develop secondary outgrowths. Transformation of tracheae into air sacs seems to depend to a large extent on increase in size of the whole body or increases in the relative size of its main regions. Fusion of air sacs seems to be mainly a continuation of the first mentioned transformation. Some features of taxonomic interest in the tracheal system are discussed. It was found that besides normal tracheae (with ctenidia) and air sacs (without obvious ctenidia) there are also tubular connectives which resemble tracheae but lack ctenidia.

39. On the morphology and histology of alimentary canal of the Dragonfly, Crocothemis servilia (L).

Z. M. HAKIM, Delhi.

Literature on the digestive system of Odonata is scarce. Tillyard (1917) dealt with this system in his book 'Biology of dragonflies', and since that date no further work on the anatomy of dragonflies has been attempted.

The alimentary canal of this dragonfly is distinguished into three main regions, the *stomodaeum*, the *ventriculus* and the *proctodaeum*. A pair of salivary glands is present in the prothorax, and reservoirs are situated along the course of their ducts. The stomodaeum can be divided into four regions, the pharynx, oesophagus, crop and proventriculus. The proventriculus unlike that of the larva is not provided with any powerful armature. The narrow part of the proventriculus forms the *cardial valve*. The formation of the cardiac valve is a device to prevent regurgitation of food.

The ventriculus is a cylindrical tube and its cells show mesocrine and the holocrine modes of secretions.

The proctodaeum is divisible into two regions, *ileum* and *rectum*. Rectum consists of the rectal pads, which help in the absorption of water. At the junction of ventriculus and proctodaeum is a *pyloric valve* which regulates the flow of fluid from malpighian tubules and the undigested food from the ventriculus.

The histology of various parts and the communication of the malpighian tubules with the alimentary canal are dealt with in the paper.

40. Male genitalia of the Indian Yellow Wasp, Polistes hebraeus Fabr.

S. S. SEHGAL, Delhi.

The external male genitalia appear to be *phallic structure* on account of the absence of *periphallic organs* or *claspers* in it. The phallus is a large, complex structure which consists of two median unpaired and three paired parts. Of the median parts, one is a basal ring like *gonocardo* and the other is elongated penis or *aedaegus* which is slightly swollen distally. The three paired structures occupy the lateral sides of the aedaegus. Largest and outer of these are the *gonostipites* which correspond to the *parameres* of other insects. The other two paired structures are the *volsellae* and the *sagittae* present in the mesal cavity of large stipes of their side. The entire phallic structure remains concealed in a genital chamber formed dorsally by reflected eighth tergum and ventrally by eighth and ninth sterna fused together which are termed as *hypandrium.*

The internal genitalia consists of a median inverted heart-shaped *testis,* that lies on the dorsal side of the mid-gut and remains embedded in a very thick layer of fat tissue. The testis is pointed in front and bilobed behind. From each of the testis lobes arises a *vas deferens* which dilates in the middle of its length to form *seminal vesicle.* Near each seminal vesicle is associated a small, roundish *accessory gland.* The vasa deferentia of the two sides, near the last abdominal nerve ganglion, become contiguous and enter the phallobase, in the lumen of which they unite to form *ductus ejaculatorius* which after traversing about half the length of the aedaegus opens in it by means of *male gonopore.*

Histology of the different parts is given in the paper.

41. Skeleto-muscular system of the Red Cotton Bug Dysdercus koenigii (Fb(. Part II. The neck and the thorax.

SUDARSHAN KUMARI, Delhi.

The neck of the red cotton bug is attached to its prothorax and it is formed of a membranous band-shaped ring. The prothorax overlaps the anterior part of the mesothorax and is devoid of any phragma. The pronotum is laterally extended in the form of a fold; the subnotum, is fused with the pleuron to form the pseudopleuron. The prosternum is a flat broad quadrangular sclerite divided internally by a V-shaped prosternal ridge into an anterior basisternum and a posterior sternellum.

The mesothorax is attached to the prothorax by the intersegmental membrane and is fused with the metathorax to form the pterothorax. The mesonotum is very well developed and is roughly triangular in shape. Anteriorly it bears the first phragma which projects under the pronotum, while posteriorly it bears the second phragma which is concealed under the scutellum.

The metathoracic sclerites are based on the same general plan as those of the mesothorax, since both are concerned with the movement of the wings.

The episternum and the epimeron in all the three thoracic segments extend in the form of flaps at the coxal base and form supracoxal episternal and supracoxal epimeral lobes.

The musculature of the thorax is described in the paper.

42. On the sclerites and musculature of the head capsule and head appendages of the Indian house cricket—Gryllodes sigillatus.

J. S. NARULA, Delhi.

The head in *Glyllodes sigillatus* is broad with three ocelli. The coronal and frontal sutures are very well marked. The epistomal suture is arched upwards in the middle region and the anterior tentorial pits are very broad extending from the lateral ends of this suture on to the mesal half of the subgenal suture. The base of anterior tentorial arms has a narrow finger-like projection near its lateral end which extends upward on to the gena. Clypeus is incompletely divided into anterior and posterior parts by a pair of lateral transclypeal sutures. The facet for the articulation of the posterior condyle of the mandible is formed jointly by the lower mesal angle of the postgena and the lower edge of hypostoma. A well developed hypostomal ridge is present. The antennifer is tri-radiate with the shorter side attached to the antennaria while the other two curve inwards and abut against the lower outer part of the antennal base. The second antennal segment does not possess any hair, while all the segments of flagellar region possess a ring of minute hairs towards their distal ends.

Some interesting features have also been noticed in the musculature. Besides the abductor and adductor muscles, each mandible possesses an intrinsic muscle which stretches across it from its outer to the mesal edge. The distal bundle of adductor of cardo has some of its fibres inserted on to the lower side of the cardo-stipital ridge while the rest are fixed on its upper side. Long cranial flexor of lacinia arises from the postgena near the base of the protractor muscle of the maxilla. This muscle has not been mentioned in *Gryllus assimilis* Fabr by Du Porte (1920). There are six pairs of ventral dilators of the cephalic part of the stomodaeum arising from the dorsal side of the posterior half of carpotentorium.

43. The Proventriculus in Xenopsylla cheopis.

P. J. DEORAS and A. K. JOSHI, Bombay.

The proventriculus of *Xenopsylla cheopis*, as that of other fleas is an important organ from the point of view of plague transmission. In the comparative study of the proventriculus of *X. cheopis*, *X. astia*, *Ctenocephalides canis*, *C. felis* and *Echinophaga gallinecea*, a distinction has already been met with in the number of teeth in male and female specimen. There are more teeth in female than male. The numbers being : *X. cheopis* ♂199 ♀381, *X. astia* ♂291 ♀554, *C. canis* ♂380 ♀722, *C. felis* ♂212 ♀429 and *E. gallenacea* ♂160 ♀216. There are four distinct rows of teeth, with their converging pointed ends in, the centre of the stomach. They are so arranged as to act as strainers and detainers for the food entering the stomach. The complexity of the teeth and their greater number in the females point out that probably the female of the species is a better transmitter.

44. Endocrine control of egg laying in the insect Iphita limbata Stal.

K. K. NAYAR, Trivandrum.

On the basis of experimental and histological studies made, it is concluded that there is an endocrine basis for oviposition in the insect *Iphita limbata* Stal., (Pyrrhocoridae : Hemiptera), a common bug of South India. Oviposition is brought about in the gravid female by a hormone complex involving the interaction between the ovary and the neurosecretory system. It works out probably as follows :

Neurosecretory matter from the cells of the pars intercerebralis of the brain passes along the axons of the allatic nerve to the corpus allatum. This stimulates the gland and consequent egg growth by yolk deposition occurs. When eggs become full grown and ripe, the ovary releases a substance into the blood which exerts a dual action on the neurosecretory system. It inhibits the neurosecretory supply to the corpus allatum and thus inactivates the gland and stops further yolk deposition. At the same time it stimulates the cells of the pars intercerebralis to empty their contents through their axons into the blood at the aortic end. This latter release of neurosecretory matter into the blood brings about oviposition.

45. Response to touch stimuli by a Tenebrionid beetle, Gonocephalum depressum K.

A. K. DATTAGUPTA and B. B. GUPTA, Pilani.

The present paper deals with a study of thanatosis in *Gonocephalum depressum* K. in response to touch stimuli with thread and with needle. Besides, sensitivity of the different regions of the body to touch stimuli has been compared. No significant difference in the duration of thanatosis has been observed in response to the two different stimuli. Coxal segment appears to be the most excitable region. A longer period of response to touch stimuli has been observed when the antennae were amputated. The duration of thanatosis has been observed to decrease in response to successive stimuli.

46. Studies on hydrogen ion concentration, frequency of feeling and the rate of passage of food in the gut of Indian Earwig, Labidura riparia Pall., var. inermis.

KUSUMAVATI KADAM, Delhi.

Most of the physiological work in Orthoptera has been carried out by Abott (1926), Wigglesworth (1927), Swingle (1931), Snipes and Tauber (1937), Snipes (1938), Uvarov (1947), and Waterhouse (1954). There is hardly any reference regarding the physiology of digestion of Dermaptera as a whole.

Earwigs reared in the laboratory were utilized for the present study. The value of hydrogen ion concentration was found to be the same in all regions of the gut, ranging between 5·2 and 6·0.

The frequency of feeding is very irregular irrespective of sex, age and maturity. The rate of passage of food increases in insects fed on liquid diet whereas those fed on solid diet have a reduced rate. The liquid food ingested, passes into the foregut, where it remains for fifteen minutes and then enters the midgut. After five minutes it passes into the hindgut and remains there for 2 to 9 hours before defecation.

Preliminary observations on enzymes show the presence of amylase and invertase in the gut of this insect. Detailed work in this direction is in progress.

47. Discrimination between coloured and neutral surfaces in Papilio demoleus L. with special reference to its Red Sensitivity.

VIDYADHAR G. VAIDYA, Poona.

The specific preferential responses of *Papilio demoleus* to groups of colours during feeding and oviposition have already been investigated. This paper marks a further step in the study of the visual perception of this insect by investigating its ability to differentiate between each individual colour and a neutral surface, or, in other words, its ability to *recognize* each individual colour. Response to the red colour was investigated in some details. Red-vision in insects has attained a special significance as many insects have been shown to be red-blind.

Artificial flowers prepared from the coloured papers of the standardized Ostwald series and the grey papers of the Bauman series were offered simultaneously to these hungry insects. The characteristic feeding response shown by these insects to coloured surfaces was used as the basis of the experiments. The number of such responses on coloured and grey papers were counted separately and conclusions were drawn therefrom.

Each Ostwald paper reflects a broad but specific wave-length band while each Bauman paper reflects all the wave-lengths in their normal proportion as found in the 'white' light. Thus, whereas an Ostwald paper represents a coloured surface, a Bauman paper represents a neutral surface.

The results have shown that *Papilio demolcus* is capable of marked discrimination between each of the Ostwald colours and the neutral grey surfaces, and that it is remarkably sensitive to red colour.

48. Free amino-acids in various stages of metamorphosis of Apis mellifera gandhiana Nougiera Netto.

A. S. SRIVASTAVA and G. P. AWASTHI, Kanpur.

Allen S. Fox (Science No. 3203-1956) found that the relative position of free amino acids in males and females of *Drosophila melanogaster* can help in the identification of the sexes. This study was extended for the various stages of the honey bee, *apis mellifera gandhiana* Naugiera Netto. Allens paper chromatography technique was followed using n-butanol, glacial acetic acid and distilled water. It was found that the maximum number of free amino acids were detected in the eggs while the minimum number of the amino acids were found in the adult bee workers. It appears from the preliminary investigations that some of the free amino-acids are utilized in the various stages of growth of the honey bee. Further detailed work is in progress.

49. Further studies of physico-chemical factors in relation to Anopheles sundaicus breeding.

P. SEN, Calcutta.

The ecological factors such as absorbed oxygen, alkalinity, nitrites and nitrates which might be critical in the production of *Anopheles sundaicus*, a virulent transmitter of malaria in the southern tidal zones of Bengal have been discussed in this paper.

Analysis of data collected before, during and after breeding of *sundaicus* indicates that absorbed oxygen increased regularly during breeding compared to the readings obtained before breeding. Most breeding occurred when oxygen absorption fluctuated between 5 and 8 ppm.

The breeding may be possible in presence of minute trace of nitrate but not in presence of nitrite. The alkalinity of the breeding water varied between 130 and 170 ppm. in most instancs.

Data maintained for the different factors during the last 10 years show a progressive decline in the readings of salinity as time passed in the sites the species bred. While albuminoid ammonia appeared more steady during the years, free ammonia behaved erratically.

50. Incidence pattern of Apion corchori in olitorius and capsularis jute under West Bengal condition.

N. DUTT, Barrackpore.

Incidence pattern of *Apion Corchori* in *Corchorus olitorius* (JRO-632) and *C. capsularis* (JRC-212) has been studied under the West Bengal condition. The experiment was carried out in a paired plot layout with 12 replications. Weekly observations, starting 15 days after germination and continued till maturity on the intensity and extent of Apion incidence, were recorded from approximately 16·6% of the area, selected at random, from each plot (300 sq. ft.). It has been observed that the extent of Apion attack is higher in *capsularis* variety (JRC-212) than the *olitorius* variety (JRO-632) till the 9th week stage of crop growth, the difference being significant at 5% level during the 7th week stage. There is gradual increase in incidence in the *olitorious* variety from the 10th week stage onward, the difference being significant at 5% and 1% level during the 14th and the 16th week stage. It has been found that the average number of attack per plant, calculated on the basis of total population irrespective of their being healthy or attacked, was higher in the *capsularis* variety till the 11th week stage, the difference being significant during the 2nd, 4th and 7th week stage at 5%, 1% and 5% level respectively. In later stage of growth such average number of attack was higher in the *olitorius* variety than the capsularis one and the difference was significant at 1% level from the 13th week stage onward.

Thus, Apion incidence, though higher in *capsularis* variety (JRC-212) during the early stage, gradually increases in *olitorious* variety (JRO-632) resulting in significantly higher attack in the *olitorius* than in the *capsularis* jute variety.

51. On the abundance of grasshopper, Acrotylus sp., in relation to some environmental factors.

B. B. GUPTA, Pilani.

The number of *Acrotylus* sp. has been estimated in *classified experimental* plots. The classification of the plots has been based on the wet or dry nature of the soil, thick or thin vegetation. Observations were made during bright sunlight and during diffuse or dull sunlight.

The *Acrotylus* has been observed to be significantly large in number in the plot with dry soil, thick vegetation and bright sunlight. When the sun was dull the said hoppers were still less frequent. The number of *Acrotylus* was still less in plots with dry soil, thin vegetation and dull sunlight.

52. Studies on the insect population of Pilani (Rajasthan). Part I. A preliminary survey with light-trap.

H. L. KUNDU, A. K. DATTAGUPTA and B. B. GUPTA, Pilani.

A preliminary survey of the insect population of Pilani (Rajasthan) with the help of a light-trap has been undertaken. Nearly 60 species belonging to 25 families have been recorded. It is noted that many of these insects e.g. *Dorylus* sp. (Formicidae), some weevils (Curculionidae), most cockchafer beetles (Scarabaeidae), *Lytta* sp. (Meloidae), *Gryllus* sp. (Gryllidae) etc. show fluctuations in their incidences characterised with definite peaks. Attempts are being made to study these fluctuations with special reference to crop pests and also to correlate such fluctuations with meteorological conditions.

53. Rate of development of Bracon (Microbracon) gelechiae (Ash) under different temperature and humidity conditions.

S. PRADHAN and D. S. KATHURIA, New Delhi.

The lower limit of temperature for the egg development was found to be between 5-10°C, the upper limit was between 35-40°C. The incubation period was 23·4 days at 10°C and 0·7 days at 35°C at 35% R.H., while at 75% R.H. it was 16·4 days at 10°C and 0·6 days at 35°C. The percentage viability of eggs at 35% R.H. was 20·6, 65·2, 58·7, 48·2, 44·1 at 10, 20, 25, 30 and 35°C respectively. At these temperatures the viability under 75% R.H. was 26·7, 66·2, 62·9, 60·9 and 69·1% respectively. The lower limit of temperature for larval development was near 15°C and the upper was near 40°C. The larval period was 5·4 days at 15°C and 2·4 days at 35°C with 75% R.H., while at 35% R.H. it was 2·6 days at 20°C and 2·0 days at 35°C. The percentage of larvae which successfully pupated was 59·1, 62·2, 58·6 and 36·6 at 20, 25, 30 and 35°C under 35% R.H., while under 75% R.H. it was 34·1, 72·8, 72·8, 67·1, 33·8 at 15, 20, 25, 30 and 35°C. The lower limit of temperature for pupal development was between 10-15°C and the upper between 35-40°C. The pupal period was 11·7 days at 20°C and 5·0 days at 35°C with 35% R.H., while at 75% R.H. the pupal period was 15·5 days at 15°C and 3·8 days at 35°C. The percentage of emergence from pupae under 35% R.H. was 66·6, 77·3, 70·8 and 36·3 at 20, 25, 30 and 35°C respectively, while under 75% R.H. the percentage emergence was 50, 82·6, 84·1, 79·2 and 50% at 15, 20, 25, 30 and 35°C. To the period required for completing full life cycle, the following equation has been fitted :

$$Y = 13{\cdot}01_e - {\cdot}001065\ (96{\cdot}7 - t)^2$$

The adult longevity was 26 days at 10°C and 3 days at 35°C. The parasite laid the maximum number (105) eggs at 25°C.

54. Studies on the population of lice infesting goats.

R .P. CHAUDHURI and PAVAN KUMAR, Izatnagar.

Studies have been undertaken to find out the population fluctuation of different species of lice infesting goats in different seasons, their distribution on different parts of the host's body, and to investigate the factors such as age, breed, nutritional level and nature of the coat etc. of the goat that may contribute towards the lice infestation. Two species of lice-one sucking *Linognathus stenopsis* (Burm.) and the other biting *Damalinia caprae* (Gurlt) have been found to infest goats in this part of the country. The maximum density of the population of the sucking type has been recorded during mid-February to end-March. Their number reached the lowest level during June-August. There was another peak period, a smaller one, in September-October. Population of the biting type of lice had been observed to be highest during September-January and lowest during March-July. This species of lice is mostly found on the long haired regions of the hind legs and back of goats but sucking lice are more numerous on their shoulders and neck regions. The study is in progress.

55. On the parental care of the common European earwig, Forficula auricularia Linn. (Dermaptera).

B. K. BEHURA, Cuttack.

Although it is instinctive in the female earwig to build a nest, the male was also observed to carve out a cell occasionally. At the time of oviposition the male is expelled out of the nest. In the laboratory, there was some indication that in some cases, the female tolerated the presence of the male sometime after oviposition. The female guards her eggs against intruders. The eggs are frequently licked and shifted from one place to the other so as to keep them moist but free from fungus attack. The egg is held between the mandibles aided by the palpi. In spite of the mother's solicitude, many eggs are mildwed. Unless in a hgihly developed condition and about to hatch in two to three days' time, eggs in no case hatched in the absence of the mother. Mildewed eggs are eaten by the female earwig. If she is too much disturbed while brooding over her eggs, she eats the eggs. The mother earwig takes care of her young until late after their second moult, although the family tie is not broken till late fourth instar. When a female lays a second batch of eggs, she ceases to show interest in her young even before they have completed the second instar. No parental care is noticed in the male who eats away the eggs whenever it gets an opportunity.

56. Relative toxicity of insecticides administered by injection to different stages of Schistocerca gregaria Forsk.

S. PRADHAN and AJAI MANSINGH, New Delhi.

Hoppers 36±6 hours old and adults 15 to 26 days old since their last moult were used in these investigations. Each individual was separately weighed and then a known quantity of the insecticide emulsion was injected into its haemocoele by means of a micrometer syringe. After injection the insects were kept in clean containers with fresh food. On the basis of mortality occuring during 72 hours after injection the values of L.D. 50 (MLD) givien in the table below were calculated.

Insecticide	MLDs of different stages in mg/gm			
	II	III	IV	Adults
Aldrin ...	0·0001652	0·0002443	0·0002661	0·003648 ♂
Parathion ...	0·0002154	0·0004624	0·0004989	——
Dieldrin ...	0·0003245	0·0005012	0·0005848	0·005848 ♂ 0·01016 ♀
Chlordane ...	0·0004467	0·0007603	0·0009099	0·005916 ♂
Endrin ...	0·0006324	0·0015	0·002208	0·01146 ♂ 0·01409 ♀
Isodrin ...	0·0008337	0·001742	0·00236	0·01804 ♂
Diazinon ...	0·001578	0·002366	0·00377	——
Lindane ...	0·002547	0·004217	0·00492	——
HETP ...	0·003491	0·004375	0·004932	——
Systox ...	0·004365	0·0052	0·005768	——
Pestox ...	0·01396	0·01862	0·03882	——
Malathion ...	0·02761	0·03006	0·04426	——
Toxaphene ...	0·03536	0·0472	0·04875	——
DDT ...	0·04667	0·06855	0·4256	——
Nicotine ...	0·05521	0·09268	0·5129	——

57. Bioassay of relative toxicity of insecticidal films to just-hatched Larvae of Chilo zonellus swinhoe (Pyralidae : Lepidoptera).

S. PRADHAN and N. SHI, New Delhi.

Larvae of *Chilo Zonellus* Swinhoe ranging in age from 0 to 24 hours were exposed to films prepared with various cencentrations of the emulsified solutions of different synthetic organic insecticides for a period of 30 minutes. Thereafter these larvae were removed to clean containers and kept on normal food. The following regression equations were fitted to the observation on concentration mortality relationship.

COMPARATIVE TOXICITY OF DIFFERENT INSECTICIDES TO JUST HATCHED LARVAE OF *Chilo zonellus* SWIN.

Sl. No.	Insecticide	Heterogeneity $P=0\cdot05$*	Regression equation	LC 50%	Fiducial limits of LC 50%	Relative toxicity
1.	Parathion ..	$\chi^2_5=1\cdot387$	$Y=1\cdot724X+3\cdot613$	0·0006383	0·0007725 0·0005041	123·4
2.	Lindane ..	$\chi^2_4=0\cdot202$	$Y=1\cdot658X+2\cdot119$	0·005470	0·005721 0·005220	14·4
3.	Malathion ..	$\chi^2_4=1\cdot408$	$Y=1\cdot037X+3\cdot103$	0·006745	0·006903 0·006587	11·8
4.	Endin ..	$\chi^2_5=1\cdot631$	$Y=1\cdot170X+2\cdot835$	0·007079	0·007231 0·005927	11·1
5.	Dieldrin ..	$\chi^2_5=0\cdot461$	$Y=1\cdot336X+2\cdot421$	0·008511	0·008654 0·008368	9·3
6.	Isodrin ..	$\chi^2_4=0\cdot160$	$Y=0\cdot974X+2\cdot915$	0·01384	0·01402 0·01366	5·6
7.	Aldrin ..	$\chi^2_5=0\cdot616$	$Y=1\cdot163X+2\cdot190$	0·02576	0·02591 0·02561	3·0
8.	DDT ..	$\chi^2_6=1\cdot855$	$Y=0\cdot788X+2\cdot717$	0·07889	0·07901 0·07877	1·0
9.	Toxaphene ..	$\chi^2_5=1\cdot565$	$Y=1\cdot\ 66X+1\cdot124$	0·2109	0·2110 0·2108	0·37
10.	Chlordane ..	$\chi^2_4=0\ 612$	$Y=1\cdot496X-0\cdot128$	0·2679	0·2680 0·2678	0·29

Y = Probit kill. X = log (concentration × 10^4). LC50 = Concentration calculated to give 50% mortality.

* In none of these cases the data were found to be significantly heterogeneous. χ^2 = Chi square.

58. Preliminary studies on the insecticidal properties of chlorinated turpentine. Part I.

M. B. NAIDU, (Mrs.) Z. H. OSMANI and S. H. ZAHEER, Hyderabad-Dn.

Chlorinated turpentine containing 60·5% chlorine (prepared in the Regional Research Laboratory, Hyderabad, by Shri Bharat Bhushan) was tested for contact insecticidal properties using the following three different methods; (1) Topical method (2) Direct spray method (3) Filter paper' method, on housefly (*Masca nebulo*), *Tribolium castaneum*, and *Brachus chineusis. L.*

It was found that with topical method at 5% concentration, hundred percent mortality is produced in 4 to 6 hours. But when sprayed directly over flies, hundred percent mortality is produced at 3% concentration in 24 hours. It was also observed that male flies were more susceptible to the insecticide than female flies. This insecticide has no knock down property and the symptoms developed were similar to that of DDT.

Chlorinated turpentine at 4% concentration produces hundred percent and 70 per cent mortality of *B. chineusis* and *T. castanium* respectively in 48 hours. Residual toxicity studies show that the insecticide is toxic to *B. chineusis* in the first three weeks at 4% concentration, but later on decline in toxicity appears.

It is concluded from the results that chlorinated turpentine is a promising contact insecticide.

59. Chlorinated turpentine as a house fly larvaecide. Part II.

(Mrs) Z. H. OSMANI, M. B. NAIDU and S. H. ZAHEER, Hyderabad Deccan.

Chlorinated turpentine containing 60·5 percent chlorine was investigated to determine its toxicity in the form of emulsion aginst housefly (*M. nebulo*) eggs and different instar larvae. Tests were carried out by placing eggs and larvae between two layers of media previously mixed with the insecticide. Formation of normal pupa was taken as a measure of toxicity.

Chlorinated turpentine was found to be ineffective towards eggs. At 0·025 per cent it was found to be highly toxic to 24 hours old larvae, but produces about 60 per cent mortality in four days old larvae. When the concentration is increased to 0·05 per cent, hundred per cent mortality is produced in 4 days old larvae. Duration of the life cycle of the housefly is increased at lower concentration.

Residual toxicity studies show that chlorinated turpentine is toxic to the larvae of earlier instar in the first two weeks. But a decline in the mortality of larvae was observed in the third and fourth weeks.

60. Relative response of soil-inhabiting larvae to methyl bromide.

H. L. KUNDU, Pilani.

Mortality of some Elaterid and some Scarabaeid larvae owing to fumigation with methyl bromide has been studied. The larvae were fumigated in air-tight steel chambers at a constant temperature of 20°C. and observed for recovery for a fortnight, the doses being measured in terms of mg./hr./lit. The Elaterid larvae were *Agriotes obscurus/sputator* L., *Athous haemorrhoidalis* F., *Elater rufipennis* Steph. and the Scarabaeid larvae were *Cetonia aurata* L. and *Serica brunnea* L. The LD_{50},s of the larvae were estimated from the regression lines and found to be of the order of 44, 46, 62, 57 and 68 mg./lit./hr. for the above mentioned genera respectively. The median lethal dose of soil-inhabiting wireworms (*Agriotes* and *Athous*) are almost same. This homogeneity in response might be either due to the similarity in their physiology or their environment or both.

61. A study of the effect of methyl bromide on soil-insects with radio-active tracer.

H. L. KUNDU, Pilani.

Larvae of *Agriotes obscurus* L. (Elateridae) when fumigated with methyl bromide, suffer from accumulation of water into their bodies. This post-fumigational accumulation of water has been demonstrated by using labelled water. After fumigation both fumigated and control larvae were kept in contact with tritiated water of the strength of 1 millicurie per millilitre for 72 hours after which the radio-activity of the water content of these larvae was measured. As the radio-activity of the labelled water was owing to alpha particles (and not due to high energy beta particles of gamma rays), ordinary Geiger counter with a window thickness of 10 mg./cm.$_2$ placed with a conventional lead castle could not be employed. Consequently the activity was measured by Gas counter and Proportional counter. C.P.M. (counts per minute) with Proportional counter was of the order of 71,0000 and 25,0000 for treated and control larvae respectively. Similarly with Gas counter it was 53,000 and 32,000 respectively. Thus radio-activity of the water from the treated larvae was always considerably higher than the radio-activity of the water from the control larvae. This clearly proves that the water-content of the fumigated larvae is higher than the unfumigated (control) larvae.

62. The effects of the concentration of insecticide and the period of treatment on the response of some beetles.

A. K. DATTAGUPTA, Pilani.

The influences of initial treatments with graded concentrations of pyrethrum or BHC for fixed period and with fixed concentration of pyrethrum or BHC for graded times on the response of *Calandra granaria* L., *Callosobruchus chinensis* L., *Tribolium castaneum* Herbst. and *Tenebrio molitor* L., on a second occasion of testing, have been compared. Response in second assey appeared to depend on the initial treatment. Their magnitude gradually increased with the increase of the concentrations or periods of exposure of the initial treatment, although the influence of the concentration differences seemed more important than that of changes of exposure period. Linearity of the points derived from the different set of experimental data to the logarithm of the concentration-time product has been tested.

63. Response of houseflies to BHC residue on brick surface.

A. K. DATTA and D. DASGUPTA, Pilani.

Toxicity of BHC deposits on the surface of bricks as well as the period of persistence of the toxicity of the same deposits have been studied. Houseflies (*Musca domestica*) were treated on the same sets of bricks with the insecticide deposit at intervals of five days. An examination of the experimental data reveals that the potency of the films on bricks remains unaltered for practical purposes during the period tested.

64. Loss of body weight a primary response of some insects to Pyrethrum.

A. K. DATTA GUPTA, Pilani.

Some members of the family Tenebrionidae (*Tenebrio molitor, Tribolium castaneum, Tribolium confusum*) and *Coccinellidae* (*Coccinella septempunctata, Adalia bipunctata*) show considerable loss of body weight when treated with pyrethrum. It has been found that treatment with plain oil carrier does not produce this effect.

The maximum loss of body weight for different periods of exposure occured at different concentrations. The physiological progress of losing body weight continues as long as the insect can withstand the given dose. The insects cease to lose weight long before the peak of the concentration-response curve is reached due to paralysis which was quickly effected by high concentrations of pyrethrum. The reciprocals of the maximum losses in different treatment periods have been found linear. An investigation of the response of these insects to air of different humidities was also made. Loss of body moisture, under such circumstances, was independent of loss associated with pyrethrum paralysis.

65. A preliminary note on the insecticidal effect of a new compound Bromo-oxymethylene-acetophenone.

H. S. CHAUDHURY and O. P. KHANDELWAL, Naini Tal.

This paper deals with the preliminary findings on the insecticidal properties of a new compound α-formyl-α-bromoacetophenone (Garg and Bokadia, *J. Indian*

Chem. Soc. 1956, 33, 353). A series of laboratory trials were made with the common Silver fish, *Lepisma sp.* The results of these experiments have so far shown that this compound acts as an efficient contact poison on these animals. It has 100% killing effect in 24 hours time when applied both in the dust as well as colloidal watery spray form containing about 5-10% of the compound. The insecticidal properties of this compound were also tested on the nymphs of Pentatomid plant-bug, and were found to be similar to those observed on the Silver fish. Further experiments regarding its exact toxic dose, residual effect and effect on human beings are still under investigation.

66. Deterioration of DDT residues on Plant Materials and other Surfaces.

A. S. SRIVASTAVA, P. C. NIGAM and G. P. AWASTHI, Kanpur.

Certain experiments have been conducted to study the rate of decomposition and deterioration of insecticidal material on plant and other surfaces after application. DDT in emulsion form has been sprayed on the mango leaves and glass surfaces, and the rate of decomposition of DDT residues under the weathering condition; ultra voilet light, infra red, direct sunlight and under shade has been investigated. It was found that DDT gets decomposed earliest under infra-red light. This rapid decomposition takes place within six hours. In the mago leaves it was found that treatment of leaves with 0·25% DDT emulsion brings down the residue from 32 p.p.m. to nil within a period of three months, in case the leaves are directly exposed to sunlight and the rains, but under the orchard conditions, where the leaves and trees are generally protected from sun light and direct rains, the detorioration of DDT is much lower.

Further investigations are in progress in this direction.

67. Preliminary experiments on Diazinon against adult mosquitoes.

H. M. L. SRIVASTAVA, Lucknow.

Laboratory experiments were carried out on Diazinon, a product containing chiefly Phosphoric acid esters, aginst adult mosquitoes, Anopheles and Culex. The mosquitoes were treated with the insecticidal film spread over pieces of filter paper. The percentage of mosquitoes found normally active were recorded after one hour of treatment. About 12 sets of experiments were performed. Anopheline were found to be more susceptible to Diazinon than Culicine mosquitoes. The percentage of Anopheline and Culicine mosquitoes found normal after one hour of treatment ranged between 33-75% and 46-100% respectively.

68. Studies on the development of DDT-resistance in housefly Musca nebulo F.

R. P. CHAUDHURI, Izatnagar.

A series of laboratory trials had been carried out to see whether or not the housefly, *Musca nebulo* F., in the Indian Veterinary Research Institute area at Izatnagar, which is being sprayed with DDT for the last about 10 years, had developed any DDT-resistant strain. Laboratory bred progenies of *M. nebulo* collected from this area and from a distant village never sprayed with any insecticide were treated with DDT under similar conditions. In each case the percentage of flies knocked down in 10, 15, 20 and 30 min. of exposure and dead 24 hour thereafter had been recorded. Of the total 830 flies of the village stock 52·4%, 64·2%, 22·5% and 25·2% were males, knocked down in 30 min., dead males and total (males and females) dead respectively. The corresponding figures for the 742 flies of the Institute stock were 40·3%, 62·4%, 18·5% and 22·8%. The evaluation of the result by statitstical method is in progress but from the above noted figures it does not appear that DDT-resistant strain had developed in *M. nebulo* of the Institute area.

69. Some coleopterous pests as a source of Cantharidin.

O. S. BINDRA, Gwalior.

Cantharidin has a high blistering power and is valued as a hair-tonic for certain types of baldness, as a blistering agent for relief of internal inflammation, and in animal breeding. It used to be imported from Europe where it is extracted from *Cantharis vesicatoria.* That dried *Mylabris pustulata* Thub. adults which occur as a minor pest of cotton, cucurbits, cowpeas, red gram, *Tenai, Hibiscus cannabinus* and *H. rosa-sinensis* etc. in India, contain 1·35% free cantharidin by weight, has been made known by Iyer and Guha in 1931.

Now, *Cylindrothorax picta* Cast. and *Lytta actaeon* Cast. which occur as a serious pest of 'Bajra' and *Mylabris tiflensis* Bill. which damages seed-lettuce around Gwalior have been found to yield 1·94, 3·46 and 2·14 per cent of dry body-weight as cantharidin. *M. tiflensis* can be easily hand-collected in the early mornings in April-May from lettuce blossoms. *C. picta* and *L. actaeon* may be best collected by light-trapping. The extraction of cantharidin from these will be profitable and also the losses due to these pests will be prevented by their removal for this purpose.

69-a. Tests with "Pybuthrin" insecticides as space sprays against mosquitoes and house flies.

P. BALARAMA MENON, Poona.

Shell Bulk Insecticide Concentrate No. 2 said to be a formulation of synergised pyrethrum equivalent to 2 per cent pyrethrum (pyrethrins I and II) concentrate, containing 0·5% pyrethrum plus 4% piperon butoxide, was tested with normal pyrethrum extract for comparison, against mosquitoes (*Culex fatigans* wied.) and houseflies (*Musca nebulo* wied). The insecticides were diluted to give a strength equivalent to 0·1% pyrethrum and sprayed inside cages in which were released a specified number of the test insects. Controls were kept separately for each experiment. Two hours after spraying, Pybuthrin gave 70% kill of mosquitoes compared to pyrethrum extract 65%. As regards houseflies, two hours after spraying, Pybuthrin gave 96% kill compared to 92% obtained with pyrethrum extract. Thus Pybuthrin was found to compare very favourably with pyrethrum extract as a space spray against mosquitoes and houseflies.

69-b. Diesel Fuel Oils as Mosquito larvicides.

P. BALARAMA MENON, Poona.

Two new Shell products Diesel Fuel Light High Pour Point and Diesel Fuel light Low pour point oils were tested with Malariol as a standard against mosquito larvae of *Culex fatigans* Wied. and *Anopheles subpictus* Grassi. The tests were conducted for (i) toxicity, (ii) Spreading coefficient and (iii) Film stability. The methods adopted were as described by Herms and Gray (1944), keeping in view the specifications laid down by the Indian Standards Institution for mosquito larvicidal oils. Preliminary tests indicate that D. F. L. High Pour Point oil can compare favourably with Malariol as a larvicidal oil both against anophelines and culicines. The D. F. L. low pour point oil has not given very satisfactory result regarding toxicity and hence cannot be preferred to Malariol or D. F. L. High. Against *Anopheles* larvae, however, it has given a higher percentage of kill than in the case of *Culex*.

69-c. Acorus calamus Linn.,—A Plant Insecticide.

T. D. MUKERJE and B. MUKERJI, Lucknow.

The ether, petroleum ether and alcohol extracts of *Acorus calamus* Linn., rhizome, have been examined for their properties as a contact insecticidal activity stomach poison and for their ovicidal and residual toxicity against laboratory bred and standardized houseflies (*Musca nebulo*, Linn.), and silk-worm (*Bombyx mori* Linn.) larvae and eggs.

DDT and pyrethrins were used as a standard for comparison. The standard method of assessing the toxicity was followed and the analysis of data was made by the standard method of probits and dosages. The apparatus used throughout was "Potter's Tower."

When used as a contact insecticide against housefly (*Musca nebulo*) adults the concentrates exhibited a toxicity about 15 times less than DDT. As a stomach poison the ether extract was toxic to the larvae of *B. mori*, and showed some effect, but high concentration was required. The extract showed no residual toxicity.

The potency of the extracts is therefore of a limited nature. But it is possible that further purification of the concentrates may lead to increase in potency.

70. On a new species of Caloglyphus (Tyroglyphoidea : Acari).

K. KANUNGO and B. K. BEHURA, Cuttack.

The different stages of a new species of *Caloglyphus* found on stored potato are recorded.

Caloglyphus Utakalensis n. Sp.

Male :—Length of idoisoma—av. 0·616 mm.

Body divided into four distinct regions by three transverse lines. Vertical internal setae barbed at their distal halves. The bases of the vertical internal setae open and pitcher-shaped. Pseudostigmatic spines plume-like. Each tarsus terminates in a curved claw whose base is partially enveloped by a pulvillus. A sensory club present on each of tarsus I and II. Suckers on tarsus IV situated at distances of 0·028 mm. and 0·055 mm. from the joint of the tarsus.

Female :—Length of idoisoma—av. 0·688 mm.

The female more or less resembles the male except the genitalia. The genital opening is surrounded except at its posterior end by thin chitinous frills which become wavy posteriorly.

Hypopus :—Total length—av. 0·277 mm.

Oval, pale brown and flattened. Dorsally along side the median line run two rows of spines. Ventral side concave, somewhat boat-shaped. The sucker plate lies behind coxae IV. It is broader than long. On this plate are arranged five pairs of suckers of which the two posterior are smaller than the two anterior. The middle pair are the longest. An additional pair (anal suckers) lies between coxae IV.

Tarsus I terminates in a claw at the base of which are inserted two sickle-shaped setae, one hammer-shaped seta and two spines.

71. Preliminary studies on the effect of synthetic food on Caloglyphus Sp. (Tyroglyphoidea : Acari).

K. KANUNGO and B. K. BEHURA, Cuttack.

The effect of synthetic food on the potato root mite *Caloglyphus* sp. is studied. It was found that the growth and longevity of the Tyroglyphoid species depended on the amount of dried yeast in the culture medium. If the culture medium was made bacteria free by the addition of Methylene Blue, the longevity of the mites decreased but strangely it gave rise to hypopi and heteromorphic male forms.

72. A preliminary list of the fishes of Tripura.

P. V. NAIR, Agartala.

Tripura, almost cut off from the rest of India, and lying in between Assam and East Pakistan, with its about 95% fish eating population is not self sufficient in its fish production despite the vast stretch of water that it possesses. As a preliminary to the development of its fisheries, a survey of the fish fauna of this territory with special reference to the ecological aspects has been attempted. References to the fauna of Tripura, particularly the fishes of Tripura are very scanty in well known works of the fauna of the eastern and northeastern parts of India. A classified list of the fishes of Tripura and the climatic geographical and physical conditions of the area are given in this paper. The collection under report was made during the years 1954-'56, from the various lotic and lentic water systems inside the territory. *Fiftytwo* species of fishes belonging to *twenty* different families are listed in this paper. Reference has also been made to the seasonal abundance of these fishes in this area. Further work is in progress.

73. Notes on two deformed specimens of the Indian Carps, Cirrhina mrigala (Hamilton).

H. L. SARKAR and N. K. KAUSHIK, Delhi.

This paper deals with the deformities of two specimens of *Cirrhina mrigala* (Ham.). The malformations of the external features along with fins and the vertabral column of the above mentioned fishes were studied. Both the specimens were with coalescence of vertebrae and with bends.

References have been made about the classification of the deformed fishes. The nature and the probable causes of the abnormalities have been discussed.

74. On the swim-bladder and its relation with the internal ear in the Genus Notopterus (Lacepede).

P. V. DEHADRAI and M. CHANDY, Delhi.

The paper is based on the detailed morphological study of the swim-bladder and its connection with the internal ear in the two Indian species of the genus *Notopterus* (Lacepede).

The physostomous swim-bladder of *Notopterus* is a complicated structure which extends beyond the body-cavity limits both in front and behind. It presents considerable variations in the three known species which may lend an additional support for the erection of a separate subgenus as proposed by Fowler (1941), to accommodate *chitala*.

Posteriorly, each of the two forked caudal caeca and its ventrally directed diverticula are in intercommunication with those of the opposite side by means of a few vacuities, the presence of which has been established.

Anteriorly, each of the swim-bladder diverticula is in association with the internal ear of its side and this was confirmed to be through the sacculus and not through the utriculus as mentioned by Bridge.

The sacculus is large and very characteristic of the genus *Notopterus* as it gives off anteriorly a tubular diverticulum which occupies a cavity of a similar shape excavated in the prootic. The sacculus of the auditory organ gives rise to the ductus endolymphaticus which unites with that of the other side above the cerebral hemispheres and brings about an intercommunication of the auditory organ of each side through its endolymphatic fluid. Thus a complete synchronisation and refinement of the sense of hearing and hydrostatic perception has been suggested for the ear-swim-bladder connection, the presence of a large sacculus, the ventral diverticula and their filiform prolongations. Probability of sound production by the organ has also been suggested on its anatomical evidences.

The paper claiifies several statements made by Bridge (1900), on the swim-bladder of *N. borneensis.*

75. Life history and feeding habits of Cynoglossus lingua (Ham. Buch.).

M. D. K. KUTHALINGAM, Madras.

A total number of 128 eggs of *Cynoglossus lingua* was collected from the inshore plankton of Madras during the month of May 1956 of which only 82 eggs hatched into healthy pro-larvae. Though the yolk was completely absorbed within 48 hours after hatching the larvae declined to feed for about 18 hours when several items of planktonic food were offered. During this critical period of transformation of the pro-larvae into post-larvae 18 larvae died. Since 64 out of 82 survived, the physico-chemical condition of the sea water could not have been responsible. It is probable that the casualities were due to physiological defects of the individuals.

In the following study the larvae were reared upto 12 days in which stage all the taxonomic adult features were in advance. The food and feeding habits of the earliest larval stage, the juveniles and the adults are discussed in detail. At the conclusion of metamorphosis when the post larvae become juveniles and have assumed adult features, their diet consists of dead creatures available at the bottom. It is very likely that in the natural habitat the juveniles would have continued to live on bottom food.

76. Studies on the alimentary canal of the Mirror Carp.

A. S. DWIVEDI, Naini Tal.

The purpose of the present study is to correlate the structure of the alimentary canal with the feeding habits of the *Cyprinus carpio specularis.* The adult carp is mainly herbivorous, seeking food at the bottom by means of its two pairs of barbs and the protrusible lips. The fry upto 2" is carnivorous. Its lips, the barbs and the gill-rakers are poorly developed. The pharyngeal dental apparatus, as well as the horny pad, is not, as yet, fully formed.

The intestine of the early fry is short and less than its body length. As the fish grows it takes on more and more to the vegetable diet and consequently there is a continued increase in the length of the intestine till maturity. Gastric glands are not present in any part of the gut.

77. Studies on the Vertebral Column of the Mirror Carp.

A. S. DWIVEDI, Naini Tal.

The present paper deals with the detailed account of the vertebral column of *Cyprinus carpio*, lately introduced in the lakes of Kumaon. The vertebral column consists of 37 amphicoelous vertebrae, 18 trunk and 19 caudals. The first four trunk vertebrae are highly modified to form a compact bony structure intimately associated with the Weberian ossicles. A number of variations in them from Sarbahi's (1932) account of Labeo, and, Karandikar and Thakur's (1951) observations on other Teleosts, have been pointed out. The basapophyses of the hinder trunk vertebrae in the Mirror Carp, somewhat like those of *Labeo* (Sarbahi 1932), become elongated ventrally. In the first caudal they get connected by a horizontal bridge, a little before the distal ends, resulting in the formation of the haemal canal with two small haemal spines. The bridge in subsequent caudals narrows down to form a typical single large haemal spine. The last 3 caudals also, however, show some interesting variations not recorded in the carps.

78. Studies on the Appendicular skeleton of the Mirror Carp.

A. S. DWIVEDI, Naini Tal.

The purpose of the present study is to give a detailed account of the girdles and the paired fins of the *Cyprinus carpio specularis*. The scapula, the coracoid and the meso-coracoid form a compact bony mass. The cleithrum or the clavicle is the largest of all the bones forming the girdle. The scapula contributes greatly to the formation of the glenoid articulation for the pectoral fin. The latter has 15 dermal fin rays and apparently 4 radials. The 4th is a large triangular thin bony plate formed by the fusion of 3 radials.

The pelvic girdle consists of a single large thin elongated triangular bony piece, the pelvic bone. In addition to 10 dermal fin rays there is an extra curved bony piece closely applied to the first fin ray. The radials are, more or less, wanting in the pelvic fins.

79. On the occurrence of osteogenic fibroma on the pre-maxilla of an Indian Cat fish, Wallago attu (Bloch and Schneider).

H. L. SARKAR, Delhi and R. DUTTA CHAUDHURI, Calcutta.

This communication records osteogenic fibroma from *Wallago attu*. A trilobed hard |knob like big tumour was situated at the tip of the premaxilla and was covered with thick skin. Near the basal portion of the tumour hard pointed teeth like structures were present at the anterior side, while the remaining sides were with small warty projections.

Irregular structures were observed internally after cutting the tumour in the middle.

Spherules of multiple bone spicules, laminated in appearance, embedded in a fibrous matrix were observed on histological examination. Cartilage, multinucleated and spindle shaped cells were absent throughout in the section. The connective tissue did not show any sign of malignancy. Probable histogenesis and comparison of the tumour are discussed.

80. The Acoustico-Lateralis System and Sound Perception in Cat Fish.

B. S. DORAI RAJ, Madras.

A detailed report of the microscopical structure of the acoustico-lateralis system of *Macrones seenghala* has been made. Many new features have been described viz., (1) the presence of two types of lateral line segments i.e. the large-pore segment and the small-pore segment of which the former alone was found to possess the sensory unit, (2) the highly tortuous course of the pore canal, (3) the very minute hairs and the cupula on the tips of the sense cells, and (4) the two types of nerve endings i.e. the knobbed and the free intracellular endings.

A series of acoustical experiments performed on the fishes which were deprived of one or the other of the three sense organs i.e. the acoustico-lateralis system, the skin, and the ear, is reported. The frequency ranges of response and absolute threshold intensity of sound at various frequency levels have been determined for (1) normal fishes, (2) fishes in which only the ear is functional, and (3) fishes in which only the lateral line and skin are functional. A careful selection of suitably precise acoustical instruments have been used in the above experiments. The response movement of the fishes were determined not only by observational methods but also by a photoelectric electronic relay operating a kymograph using photo-sensitive paper.

It was found that the normal fishes responded to tones ranging from 15cps. to 2100cps. at a 20 decibels intensity level. Fishes in which the ear alone was functional responded to tones ranging from 40cps. to 2500cps. at a constant intensity level of 20 decibels above 1 milliwatt. Fishes with only the lateral line system and skin functional did not respond to any sounds at 20 db. level but showed some positive response for sounds of from 30 db. to 40 db. in a narrow band of low frequency i.e. 15cps. to 150cps. For normal fishes the optimum range of frequency response was found to be between 150cps. and 1100 cps. at an intensity level of as low as 12 db. over 1 milliwatt. From these findings and other experimental data and the structure of the lateral line system in this fish and other related fishes, a possible mode of functioning of the lateral line system as a mechanoreceptor and its influence over the higher sense organ viz. the ear; is discussed.

81. Anatomy and Physiology of the Alimentary Tract of Boleophthalmus Boddaerti (Day).

K. BALASUBRAHMANYAN, Annamalainagar.

The study of the anatomy and physiology of the alimentary tract of *Boleophthalmus boddaerti* (Day) reveals in particular the following features:

1. Sensory bristles are present in the pharyngeal region.
2. Gastric glands are present only in the cardiac region of the stomach.
3. Ducts from the liver are small and open into the pyloric region of the stomach.
4. The pyloric end of the stomach is guarded by a valve.
5. A powerful amylase and a weak invertase are present in the liver, stomach and intestine.
6. Trypsin is the only protease found in the liver, stomach and intestine.
7. All these three regions show lipolytic activity and the liver seems to be a far more potent source of lipase than either stomach or intestine.
8. The optimum pH of the stomach and intestinal amylase was 7·2 while optimum temperature was 43°C for both with 1% starch solution as substrate.

82. Haemathological Studies in Carp.

SRIMATI I. DAS, Cuttack.

Standard figures are not available for r.b.c. counts, w.b.c. counts, haemoglobin content and differential counts for carps like *Catla catla*, *Labeo rohita* and *Cirrhina* *mrigala.* Average r.b.c. count for the three species has been found to be 4,31,500, 4,71,000 and 4,68,500, w.b.c. count 8,172, 7,100 and 6,400 and haemoglobin content 10·0 gms., 9·7 gms. and 9·25 gms. respectively. Compared to human being the average r.b.c. count is nearly one-tenth but other figures are comparable.

83. Effect of Insulin on the Free Amino Acids of the Liver of Ophicephalus striatus Bloch.

B. SESHADRI, Annamalainagar.

After intramuscular injection of five units of insulin the following changes in the free amino acids of the liver of *Ophicephalus striatus* were observed :

1. Alanine and glutamic acid—threonine show a maximum decrease in 90 minutes after injection, and leucine—isoleucine, asparagine and histidine in 60 minutes. All these amino acids rapidly recover to the normal afterwards.
2. Glycine—serine—aspartic acid fall to the minimum in 60 minutes, but recovery to the normal sets in about 30 minutes later.
3. Valine-methionine and tyrosine increase to the maximum in an hour after injection. Valine—methionine revert to the normal level an hour after reaching the maximum. But tyrosine fails to come down even after ninety minutes after reaching the peak.
4. Ornithine—lysine which are normally absent in the liver appear an hour after injection, rise to a maximum in another half an hour and disappear an hour later.
5. Generally speaking, the glucogenic amino acids of the liver with the exception of valine—methionine, *decrease* in quantity after injection of insulin, while among ketogenic amino acids tyrosine *increases* after injection.

84. Changes in the Free and Protein-Bound Amino Acids in the Ovary and Pituitary during the gonadial cycle of Labeo fimbriatus (Bloch).

K. P. KRISHNAMURTHY, Annamalainagar.

The protein-bound amino acids of the ovary in three different stages of growth and in the corresponding stages of the pituitary have been quantitatively investigated. The free amino acids have been qualitatively determined.

Protein-bound amino acids : The mature ovary contains nineteen amino acids appearing in thirteen bands in the chromatogram. Hydroxyproline is lacking in all the stages. In the earliest stage examined Proline and Cystine are also lacking. In the intermediate stage of growth of the ovary Valine—Methionine, Tyrosine are lacking in addition, but Cystine is present.

Free amino acids : The mature stage contains eleven free amino acids which appear in eight bands. Valine—Methionine, Tryptophane, Hydroxyproline and Cystine are lacking in all the three stages. In the earliest stage and in the intermediate stage Glutamic acid—Threonine, Arginine and Proline are lacking. Lysine—Ornithine are lacking in the intermediate stage only.

During the growth of the ovary there is a progressive increase in the quantity of the protein-bound amino acids.

With regard to protein-bound amino acids of the pituitary, Hydroxyproline is lacking in all the stages, Valine—Methionine, Lysine—Ornithine, in addition, in the earliest and also mature stages, Asparagine, Cystine in the intermediate and also mature stages, in which Tyrosine and Histidine are also lacking. Glutamic acid—Threonine and Alanine are considerably greater in quantity in the early stage than in the mature stage. The reverse is the case in the ovary.

85. Free Amino Acids of some Marine Fishes of West Coast of Madras.

A. SRINIVASAN, Bhavanisagar

The free amino acids (non-protein) of a few of the fishes from West Coast have' been determined by the circular and ascending paper chromatography. Results are detailed here :—

Prawns : (*Motapenaeus monoceros*) :—Arginine, Glycine, Serine, Proline (strong) Aspartic acid, Glutamic acid, (faint) Threonin, Alanine, Lavcines, Methoionine (faint) Lysine.

"Korakutty" (*Scaeina* spp.) :—Lysine, Histidine, Aspartic acid serine, Glycine, Tryptophane, Alanine, Vaine-Methinine, Lewcines :

Ribbon fish : (*Trichiurus hanmela*) :—Lysine, Glycine, Aspartic acid, Glutamic acid, Alamine, Leucine, Valine-methionine.

Mackerel : Arginine, Aspartic acid, Glycine, Glutamic acid Methionine, Valine, Alanine, Leucine.

The differences in amino acid pattern are evident. Prawns were found to contain a wider range of amino acids than other fishes. Proline and theonine are present only in prawn.

86. On the bionomics of Sardinella gibbosa (Blkr.) off Waltair Coast.

P. N. GANAPATI and K. SRINIVASA RAO, Waltair.

The paper deals with the food, feeding and spawning habits of *S. gibbosa* off Waltair Coast. Analysis of the stomach contents of *S. gibbosa* shows that the food is mainly composed of prawn larvae, *Lucifer*, Copepods, Fish larvae, Molluscan larvae and diatoms. The presence of such of the food items as *Lucifer*, Copepods, Mollluscan larvae in the stomach contents is in direct relation with their abundance in the plankton. This shows that the fish normally feeds on the organisms that are abundant in its environment. But the presence of larger organisms such as fish larvae and prawn larvae in the stomach contents indicates that the Sardine also exercises a certain amount of selective feeding. It is doubtful to say without further work whether the fish shows a definite preference for these organisms, which might influence its migratory movements.

Appearance of mature specimens was observed in February and March. Some specimens which were in the maturing stage were also obtained in May and it is likely that the spawning period extends from February to May. The Sardine appears to become mature when it is 11 to 12 cm. and this inference is supported by the inflexion at 11 cm. in the curve of the ponderal index.

Trematode parasites of *Aponurus* sp. *Hemiurus* sp. and Nematode parasites were observed in the stomach contents of *S. gibbosa*. Of the Ectozoic parasites *Caligus* was noticed.

87. Self-fertilization and sexual periodicity in the Guppy Lebistes reticulatus.

H. SPURWAY, Calcutta.

Over twenty fish, all closely related, have produced fatherless litters. All but one have been superficially female but their self fertility is due to their gonads being ovotestes. One was superficially intersexual. The hermaphrodites and their fatherless offspring were XX or homogametic like normal females. Almost all have been superficially female. The genetics of hermaphroditism is discussed.

More than half the female fish examined in all stocks have been observed to extrude unfertilized eggs periodically. The periodicity is idiosyncratic to a given fish. The intervals between oocyte extrusion are shorter and more regular than the intervals between the births of either sired or fatherless litters.

88. The regulation of air breathing in the Koi, Anabas testudineus.

H. SPURWAY and J. B. S. HALDANE, Calcutta.

Kois ascend fairly regularly to breathe air. The mean interval between ascents is nearly proportional to the amount of oxygen in the gas breathed. When they are forced to breathe nitrogen a period of very frequent ascent is followed by one in which ascents are very irregular but not very frequent. If mineral oil is placed above the water the fish inhale it through their mouths and expel it through their opercula like a gas, the pattern of ascent being like that when nitrogen is breathed.

89. Observation on the spawn of Carps of the Mahanadi river (1).

G. N. MITRA, Cuttack.

Major carps spawn in the Mahanadi river after 22 to 40 days of the onset of monsoon and spawn has never been recorded till silt laden flood water has flown in it. There is a definite periodicity between current and downward migration of spawn pointing to spawning in the main channel in the middle portion of the river where a deep gorge exists to sustain breeders. The second spawning takes place 8 to 18 days after the first and the period of spawning may extend to 9 days. There seems to be no relationship between rainfall, lunar periodicity, height of floods and spawning.

90. Observations on the "Pearl Fishery off Tuticorin—1957" in the Gulf of Mannar.

D. D. PETER DEVADOSS, N. V. CHOODAMANI, R. VENKATARAMAN,
S. THYAGARAJAN, S. MAHADEVAN & A. D. ISAC
RAJENDRAN, Tuticorin.

The Pearl Banks Inspection in 1955 revealed the presence of oysters of age 2—3 years in the southern beds off Tuticorin. Detailed inspection of these Pearl Banks and Tholayiram Paar was taken up in December-January 1957 to follow the conditions of the stock existing. Totally 7 'Paars' at depths varying from 8-9½ fathoms were inspected as detailed by Chidambaram *et al.* (1951). 2000 random samples of the oysters taken out by naked diving from different paars were analysed for length, breadth, weight, age and pearl contents. The result brought to light an approximate population of nearly 127 lakhs of fishable oysters ranging in age from 3—4½ years. In addition a heavy spat fall over Tholayiram Paar in July-August 1956 was also noticed. This brood, if survives, will sustain a bumper fishery in 1959 or 1960.

The Hydrographical conditions of the various 'Banks' and Meteorological features over the area were observed throughout the inspection and during the Pearl Fishery which ensued. Based on the estimation of oyster population a Pearl Fishery was started on 15th March 1957 and continued till the 20th of May lasting for 51 working days. 58 canoes with 733 divers participated in the Fishery. 1,11,752,14 oysters were fished out during the period out of which Government share came to 74,08,031. The sale proceeds of oysters came to Rs. 1,66,366·87. The grand total revenue came to Rs. 1,68,807 adding the receipts from lease of sites for Pearl Bazar, etc. The Pearl yield was good this time. A comparison of this fishery with the previous Fisheries since 1899 shows that this is one of the great fisheries in Twentieth Century.

91. Report on the 'Kaaral' (Leiognathus Spp. and Gazza Minuta) 'Fishery' of Rameswaram Island in the Gulf of Mannar and Palk Bay.

S. MAHADEVAN, Tuticorin.

One of the important and economic groups of fishes which shoal around the Rameswaram Island in abundance is the Kaaral group which affords a decent earning to independent fisherfolk. They are caught in abundance in 'Madi Valai' operated from Catamarans in July, August and September on the north shore of Pamban, Thangachimadam and Dhanushkodi. 'Madi Valai' operation is briefly summarised. The 'Kaarals' (Silver bellies) of Rameswaram Island come under two genera namely *Leiognathus* and *Gazza*. Of the 2361 specimens examined from commercial catches in different years (1952-55) the following are the percentages noticed. *L. equulus* 52%, *L. bindus* 21%, *L. insidiatn* 9·6%, *L. daura* 9%, *L. ruconius* 5·5%, *Gazza minuta* 2·5%, *L. brevirostris* ·4%.

Economics of this fishery is also discussed.

92. Some preliminary observations on the prawn catches off Finakayal near Tuticorin.

R. VENKATARAMAN, P. S. SAMBANDA MURTHY, and S. MAHADEVAN, Tuticorin.

The fishery wealth of Gulf of Mannar is noteworthy. The "Pinnakayal Gut" about twelve miles south of Tuticorin in the Gulf, which was exploited by the local fishermen since ages, with their primitive tackle, has shown great possibilities of exploitation by bigger trawls, operated from power boats with winches. The results of hauls made by the Madras Fisheries Departmental vessel M. V. 'Meenakshi' over a period of three months have been analysed and the results reported. The rich potentialities of prawn fishing in this area have been indicated. The sex composition and biometrical values are indicated. A brief note on the hydrography of the ground is added.

93. A Preliminary note on the nutritive value of some of the cured food fish of the East Coast of Madras State.

R. VENKATARAMAN and C. MALU PILLAI, Tuticorin.

An attempt has been made for the first time to assess the proximate composition of the East Coast food fishes of Madras State. Proximate compositions of Sardines "Choodai" both cured and dried, "Oluguchalai", *Stolephorus* "Nethali", *Pellona*, Ribbon fish and Cat fish are given. Very high Protein content of *Stolephorus* and Sardines, and unusually high fat of *Pellona* (Thiruvenganam) and *Sardinella fimbriata*, "Choodai" are indicated. The rich minerals of *Stolephorus* and Sardines, high phosphorus in Ribbon fish and the Paucity of minerals and fat in Cat fish are also pointed out. Future line of work is also suggested.

94. Factors contributing to the rich and continuous inshore fishery of the Quilandy Bay in North Kerala.

P. C. GEORGE, Mangalore.

The Quilandy bay supports a rich and continuous fishery for soles, prawns and smaller sciaenids, in addition to being an active centre for the pelagic fishes. The bay is particularly important for its sole catches, since this fishery retains its best identity at this place almost throughout the year, whereas it is quite seasonal at other centres.

The physical and biological factors contributing to the unique fishery conditions of the bay were explored for a period of more than 3 consecutive years. A special study was made of the influence of the mudflats and mudbanks on the bay fishery. Comparative studies were also made on the planktological, hydrological and benthic conditions of the bay and of the neighbouring open coast centres including Kozhikode.

The investigations revealed that during monsoon months the soft mud released from the mudflats and from the bay bottom turns into a slimy suspension and that it exerts a very softening influence on the breakers facilitating safe launching of boats and uninterrupted operation of nets. This condition coupled with the naturally sheltered condition of the bay accounts for the continuous fishery of Quilandy. The bay was found to support a comparatively richer crop of planktonic and benthic fish-food elements, longer diatom peaks, increased nutrient contents and quicker settlement of larval invertebrates. Fish and crustacean eggs and larvae always occurred in increased proportions when compared to conditions at Kozhikode. Experimental fishing operations indicated further possibilities of profitable inshore boat-seine fishing even during the commercially closed season.

95. Brine curing in India and the Quality of Curing Salts.

A. SREENIVASAN and R. VENKATARAMAN, Madras.

Brine curing is not practised in India as widely as salt curing, but it is done in the case of prawns in Madras. The keeping quality of Semi-Dried prawns prepared thus is described. "Colombo" curing prevalent in Madras is detailed with the bacterial counts of pickled fish and brine. A noteworthy feature of the product is the reduced pH and also the decrease in number of bacteria. The peculiar 'Aroma' of the Colombo cured fish may be due to the thin motile rods and chains of cocooid rods imparting the sweet odour.

Fish under pickle did not develop 'pink' but it did so when dried. Survival of red halophiles for six months at pH of 5·4 is remarkable, as their normal growth is best at pH 7·6.

Rajputana 'salt' is microbially of high quality and is characterised by the absence of 'Ca' and 'Mg'.

96. Studies on the use of different salts for Fish Curing.

A. G. VASAVAN, Kozhikode.

The suitability of three commercial varieties of salt viz., (1) Powdery salt from Tuticorin containing 89% NaCl, (2) Crushed salt from Tuticorin containing 95% NaCl, (3) Kurkutch salt from Government Model Salt Factory, Wadala containing 98% NaCl for fish curing was studied. Mackerels were cured experimentally using these three different salts under identical conditions. The use of powdery salt resulted in inferior quantity of cured product, which naturally spoiled very rapidly. The crushed salt and powdery salt produced a superior product, whiter and more attractive in colour. Their keeping quality as studied by organoleptic tests as well as by analysis for moisture, sodium chloride and T.V.B. (Total Volatile Bases) was also much better. Considering the purity, NaCl content and grain size Wadala Salt is tentatively recommended for fish curing purposes.

97. Experiments on the preservation of fish by Pickling.

A. G. VASAVAN and K. G. VARMA, Kozhikode.

The comparative efficacy of vinegar and Malabar tamarind (*Garcina cambogea* -- Family Gulleferae) in the preservation of brine pickled fish was studied. Oil Sardines were pickled experimentally in brine containing tamarind and vinegar. The keeping quality was studied by organoleptic tests and the estimation of T.V.B. (Total Volatile Bases), T.M.A. (Trimethylamine) and bacterial count. The spoilage of vinegar pickled sardines was less rapid. They also presented better appearance and tasted better. Total viable count and halotolerant count in both cases decreased up to two months and subsequently showed a slow increase. The increase was more marked in the case of tamarind pickled fish. The major aerobic flora is spore forming rods and the anaerobic flora consists of gas producing long filaments and short rods. The superiority of vinegar over tamarind as a commercial preservative of pickled fish, is established and its use recommended to the trade.

98. On the caudal musculature of male Ptyas mucosus (Linn...

TRILOK MAJUPURIA, Shikohabad.

In male *ptyas*, the muscles of cloaca and copulatory organs play an important role in the eversion of the hemipenes during coitus, therefore, caudal musculature is worthy of special study. Hemipenes are concealed in muscles of male *ptyas* like other ophidians and are seen only after cautiously removing caudal skin. Outermost stratum of muscles is delicate, while underneath are situated dorsolterally curved stronger muscles. M. retractor caudae is inflated and backwardly drawn out of the ribs. It arises from the neural spine and proceeds obliquely to the apex of proc. Costo transversii. Mm. intercosto transversalis are intermediate transverse continuous muscles and are stretched among the proc. of Costo transversus of vertebra. M. flexor caudal superficialis originates out of the apex of pro. costo transversii. Outside it exist Mm. spinalis dori. M. flexor caudae profundus lies above the M. flexor caudae superficialis. In male specimen, M. ret. penis is situated outwardly. It originates jointly with the M. flexor caudae superficialis through a long slanting head of the apex of proc. costo transversii. Muscles of cloaca are (a) Mm. retractors cloacae and (b) Mm. sphinctor cloaca *et* ani. Mm. retractor cloaca lies under the Mm. flexores caudae superficial, which together with integument form penis sheathy covering the hemipenes. M. sphinctor cloacal *et* ani, originates under the last presacral vertebrae and are fixed by caudal vertebra. The muscle M. transversus penis lies above Mm. flexores caudae. It originates from caudal vertebra. M. retractor penis originates from the spines of caudal vertebra in the form of one roundish long muscle with one short tendon. It is inserted in caudal blind end of the hemipenis as a big retractor muscle.

Detailed description of the caudal muscles is given in the paper.

99. The morphology of the Hemipenes of the common Indian Rat Snake. Ptyas mucosus (Linn.).

TRILOK MAJUPURIA, Shikohabad.

Hemipenes in perfectly developed *ptyas*, are found as invaginated tubular pouches, on the lateral angles of anal split, concealed under the skin united inconspicuously. In embryonic condition, the copulatory organs are cone shaped but during later development change into tubular form. In *ptyas* measuring 75 inches body length hemipenis extends longitudinally *in situ* about 3 inches in length up to the 14th caudal plate. In retracted condition hemipenes are situated in deep pockets opening on right and left posterior corners of proctodaeum. Internally lumen is relatively small. Various wrinkles are also distinguishable. Seminal groove is in the form of a furrow which begins on each side of the cloaca adjacent to the orifice of the papillae urogenitalis. Histologically it consists of cavernose tissue. In erected condition seminal groove exists as a long tube for the outlet of sperms. Internally, among the folds of the hemipenes are found numerous series of small spines, which in retracted condition are pointed forward, while in everted condition of the hemipenes are backwardly directed. Spines are abundant in middle part of the hemipenis. Three or four big spines are also found to be attached proximally. Spines are cartilaginous and are regarded as contrivances for stimulating the sexual organs and also serve for gripping the female cloaca during coitus. Hemipenes of both sides are covered by a common sheath called tunica penis externa. Various spaces below the penis sheath and hemipenis are filled with loose connective tissue. In everted condition of the hemipenes, three ill defined regions can be distinguished. These are (a) basal part, (b) middle part and (c) apical part. The detailed description of the anatomical features of the hemipenes is given in the paper.

100. The Structure of the heart of Mabuya carinata (Boulenger).

S. C. RASTOGI, Pilani.

The heart of *Mabuya carinata* lies well forward in the pleuro-peritonial cavity. In an average animal it measures about 11 mm. long and 10 mm. broad. A notch is present where the pulmonary and the two systemic trunks leave the ventricle. The sinus venosus is distinctly differentiated externally, covering more than half of the auricular area. The common pulmonary vein opens in the left auricle and the opening is devoid of any valves. The sinu-atrial aperture is a transverse slit guarded by a pair of valves.

The right auricle is invariably larger than the left. A sac-like diverticulum is given out from the right auricle. The interauricular septum is cranio-caudal in direction, flaccid and wavy. The auricles open in the ventricle by atrio-ventricular cavities. The auriculo-ventricular valves are transverse and membranous and have been discussed in detail. The mode of origin, attachment and nomenclature of the *muscular ridge* has been discussed in detail. It is obliquely disposed more shifted towards the right side arising from the apex of the notch, separating a larger cavity *cavum dorsale* on the left and a smaller cavity *cavum pulmonale* on the right. The origin of aortic arches has been described. Cartilaginous nodules are also present.

101. Dehydration of urine for conservation of water in the Indian spiny tailed lizard Uromastix hardwickii (Gray).

CHAMPAKA SESHADRI, Delhi.

This lizard lives in desert conditions in burrows which are just moist. Because of the comparatively limited supply of water available to this lizard i.e., from the insects it eats or from the Xerophytic plants it nibbles, whatever little water it gets has necessarily to be conserved. This is achieved by reabsorption of water from urine which is dehydrated in the cloaca and is evacuated in the form of a solid pellet. In this respect it resembles the wall-lizard *Hemidactylus flaviviridis.* The interesting difference between *Uromastix* and *Hemidactylus* is that the bladder is functional in the former and vestigial in the latter. The liquid urine instead of reaching directly to the coprodaeum, flows through the bladder. The folds in the region of the opening of bladder are so modified as to regulate the flow of urine to the coprodaeum.

The presence of more glomeruli in the kidney of *Uromastix* than in *Hemidactylus* indicates that quantitatively more liquid urine passes on to the cloaca, which also explains the retention of a functional bladder.

102. Probable food habit of Echis carinatus.

P. J. DEORAS and N. E. VAD, Bombay.

It is evry difficult to keep *Echis carinatus* snakes in the laboratory for even short spaces of time. Attempts have therefore been made to find out the food at places where *Echis* snakes abound. Actual connections of different animals under stones in the Deogad Taluka of Ratnagiri District have shown that the maximum number of animals recovered are insects and in insects the order Dermaptera predominates. Actual dissection of the stomach contents of *Echis* snakes collected on the spot has revealed that the majority of the food contents in the stomach consisted of insect body parts in which there were a very large number of the callipers-like cerci of some Dermaptera. *Echis* snakes have been reared on a diet of Dermaptera collected in the field and the snakes fed in the field laboratory.

103. Venom tolerance in Russell's Viper.

P. J. DEORAS and MASHALKAR, B. N., Bombay.

It has been observed in a number of experiments that 0·25 cc. of Russell's viper serum neutralised nearly 2 M.L.D. of Russell's viper venom (0·5 mgm. of Russell's viper venom). On this basis a normal Russell's viper snake with about 100 cc. of total blood may tolerate 85 mgm. of Russell's viper venom.

Further work on Russell's viper serum had shown that this completely inhibited the anti-lecithinase activity of Russell's viper venom when tested on rabit blood. This serum also shows a trypsin inhibiting activity which is about three fourth that of human serum.

104. Further studies on the sinuatrial connexions of the heart of the common Indian Fowl.

RAVI PRAKASH and RAJ KRISHAN KHANNA, Bhopal.

Sinuatrial connexions of the heart of common Indian Fowl have been described. Sinuatrial node is connected to the atrioventricular node through the sinus venosus, sinuatrial valve and interatrial septum and also through numerous muscle bundles and a band of Purkinje fibres. The presence of two pathways for the conduction of the cardiac stimulus of contraction from the pacemaker to the node of Tawara has been correlated with the rapid rate of heart beat of birds. It has been argued that the cardiac stimulus of contraction which is being transmitted from the sinuatrial node to the atrioventricular node through two pathways passes through the common connecting passage formed of the interatrial septum and connecting band of Purkinje fibres, to prevent the premature excitation of the atria and at the same time ensures a rapid conduction of the impulse through the sinuatrial junction.

105. The tabular bone of certain Insectivores and its significance.

D. R. SHARMA, Raipur.

This paper deals with the morphology of a small bony element which is present posterior to the squamosal and ventral to the posterolateral edge of the parietal in the skulls of *Suncus murinus, Suncus stoliczkanus, Crocidura attenuata* and *Crocidura pergrisea*. This bone is fused with the supraoccipital and periotic. It has been concluded that the bone in question represents the tabular of the Therapsida. Such a bone had been earlier reported in *Chrysochloris, Phoca* (Broom, 1916), and *Eremitalpa* (Roux, 1947) amongst the mammals.

Parker (1885) referred to a similar bone in *Sorex* by the name "prootic plate". This, however, is questionable. Firstly because, this element does not form a part of the petrosal or periotic and secondly, no adult mammal shows prootic as a separate bony element. Roux (1947) described an autogenous ossification in the anterior prolongation of the supraoccipital cartilage in *Eremitalpa* and concluded that it represents the tabular. Such an ossification is also present in *Suncus orangiae*.

Butler (1956) and Saban (1954) favour the creation of the suborder Soricomorpha to include three superfamilies-Soricodea, Chrysochloroidea and Tenrecoidea. The presence of a tabular in the species of shrews mentioned in this paper, *Chrysochloris,* and *Microgale* (Parker's supratemporal 1885, De Beer's tabular 1937) supports this view.

106. The skull of five stripped squirrel, Funnambulus pennanti pennanti (Wroughton).

RAVI PRAKASH, JAGDISH PRASAD and SULOCHNA, Bhopal.

The skull of *Funnambulus* is akinetic, tropotrabic, monimostylic and synapsidan. The occipital condyles bear a tripartite nature. The atrophy of the interparietal throws light on the origin of rodents. Like ditrematous mammals the pterygoid is a single entity. The mesial growth of maxilla has Loricate affinities. Presence of the mesethmoid justifies the inclusion of squirrels among Neotheridae. The lacrymal is identical with that of Saurians. In the presence of united orbitotemporals, paramastoid process, pterygoid process of alisphenoid, posterior process of supraorbital, diminished turbinal, prominent periotic over basisphenoid and mucronated palatal processes the *Funnambulus* differs from other rodents.

107. The cranial peculiarities of Indian Hedge-hog, Erinaceus Indicus.

RAVI PRAKASH and JAGDISH PRASAD, Bhopal.

The craniology of Indian erinaceid exhibits modification of the sagittal crest as upper profile. Horizontal Zygoma is not elevated towards its posterior end. Postero-lateral expansion of the nasal cavity is limited. There is a distinct lacrymal with a foramen lacrymale hitherto unrecorded. There is a definite premaxillo-frontal contact. The occipital crest is well developed while the sub-orbital crest is vestigial. The premaxilla participates in hard palate. Palatines and basisphenoid are densely perforated. The supra-orbital obliterates the lacrymo-frontal union. Formen ovale, rotundum and spheno-orbital are prominent. The remnant of the alisphenoid canal is very striking. The spheno-orbital in collaboration with a septum forms the crest averting the orbito-temporal coalesces. The tympanic cavity is roofed over by squamosal and periotic and the bulla is formed by the basisphenoid and periotic. The absence of the alisphenoid both from bulla and tympanic cavity is due to the alliance of aliorbito-sphenoid with frontal as members of circumorbital series. A unique interparietal is a primitive feature. Both the processes of the angular and coronoid are hooked structures. The mandibular foramen occupies a curious position at the horizontal crest and not at the condyle. Various skull foramania have been discussed.

108. Food of the desert mammals.

ISHWAR PRAKASH, Jaipur.

The food of the mammals of the desert of Rajasthan was studied during the project 'Vertebrates of Rajasthan Desert and their role in preserving and maintaining the desert conditions' aided by U.N.E.S.C.O. The food in nature was studied by examining the stomach contents and the faecal pellets of the animals. Number and Volume methods were employed for the analysis of various food items. The food of 2 insectivores, 2 bats, 7 carnivores and 3 rodents was studied.

The insectivores depend mostly on insects but other arthropods, toads, lizards, snakes, birds, their eggs and other small mammals are also consumed. They do not eat plant material. The Flying Fox depends on fruits, while the Indian False Vampire bat was found eating other bats, mouse, gerbille, sparrow, Bush-chat and fish. Carnivores primarily feed on gerbilles, hares, birds and their eggs, but berries of *Zizyphus* are also consumed in great numbers. The gerbille, *Tatera indica indica* eats insects, lizards, smaller mammals in addition to the plant material. The Desert Gerbille restricts itself rather on plants. The fluctuations in the food of these germilles during the year have been dealt with in detail.

There exists a complex food chain among the mammals of this region. Six food centres have been recognised: (1) Vegetation, (2) Insects, (3) Lizards, (4) Birds and Eggs, (5) Gerbilles and Hares and (6) Carrion. Of these the first two are the busiest. 16 species of mammals depend on first centre, 15 on second, 6 on third, 5 on fourth, 6 on fifth and 2 on sixth. It has been observed that there is considerable inter-specific struggle for food in the desert region, a land of scarcity.

109. Behaviour of certain mammals towards snakes.

ISHWAR PRAKASH, Jaipur.

A large number of live mammals and snakes were being collected by us during a Project, 'Study of vertebrates and their role in preserving and spreading the desert conditions', aided by U.N.E.S.C.O. They were kept in large cages—90″ × 30″ × 30″, having sandy bottoms so that the burrowing mammals might tunnel. Occasionally the author had witnessed duels between mammals and snakes in nature as well as in the cages. Since the snakes are natural enemies of mammals, particularly of rodents, some experiments were conducted to study the reaction of hedgehogs, mongoose, fox and gerbilles toward different species of snakes (*Eryx, Echis, Python, Zamenis, Coluber* and *Bungarus*).

Reaction of mammals as shown toward snakes can be classified in two phases: 1. Alarm: As soon as the mammal perceives the presence of the serpent, it is immediately alarmed and behaves in different ways. 2. Panic: The stimuli is intensified to the extent as to produce hasty movements, sometimes resulting into attack on the snake.

The paper also deals with the factors influencing the reaction such as role of of scent, sight, size of the snakes etc.

110. Cytological studies on the Indian spiders.

G. P. SHARMA and M. S. GREWAL, Hoshiarpur.

This paper deals with the morphology and behaviour of the chromosomes in six species of the Indian spiders viz., *Hersilia savignvi* Lucas (Hersilidae) *Larinia* sp. (Argiopidae), *Tetragnatha* sp. (Tetragnathidae), *Ocyale kumari* Dyal (Lycosidae), *Pardosa mulani* Dyal (Lycosidae) and *Evippa praelongipes* (Cambridge) (Lycosidae).

The diploid number of chromosomes in these six species is 32, 24, 24, 22, 28, and 26 respectively and all of them are acrocentric.

The general course of meiosis is typical. The first division is reductional and the second equational for all the chromosomes—autosomes as well as the sex chromosomes. The latter precede the former in the first meiotic division.

The sex determining mechanism in the males has been found to be xxo. The two sex chromosomes are of unequal size in *Larinia* sp. and *Pardosa mulani* Dyal, while in the others they are of equal length. Their size difference is quite evident during metaphase I when they form a separate plate. Whereas during meiosis and even in 50% of the early spermatids the sex chromosomes are positively heteropycnotic they are quite indistinguishable from the autosomes during all the spermatogonial stages.

All these observations were made on the sections of the testicular material fixed in Sanfelice and stained with 0·5% iron haematoxylin.

111. Studies on the Golgi bodies and mitochondria in the living sperm-forming cells of Calotes versicolor (Daud.) by phase-contrast microscopy.

BHUPINDER NATH SUD, Hoshiarpur.

The Golgi bodies in the sperm-forming cells of *Calotes versicolor* (Daud.) appear for the first time in the secondary spermatogonia as granules of dark contrast. During the growth of the primary spermatocyte the Golgi granules align themselves to form rods of dark contrast which retain their form during meiosis I. The Golgi complement of the secondary spermatocyte consists of a few rods, which during meiosis II join end to end to form longer and slightly curved rods. In the spermatid the Golgi material is represented by a single rod-shaped acroblast, which is directly transformed into a prominent, spherical completely hyaline pro-acrosome of firm consistency. In the pro-acrosome a refringent acrosomal granule of dark contrast is differentiated which finally grows into the acrosome.

The mitochondria are seen for the first time in the secondary spermatogonia as homogeneous fibrillae of light grey contrast and they retain this form till the secondary spermatocyte stage. In the early spermatids the mitochondria are seen as fine granules of dark grey contrast which are most probably formed by the breaking up of mitochondrial fibrillae. During spermateleosis the mitochondrial granules acquire a higher phase-change and the entire mitochondrial material is relegated to the middle-piece. In the final maturation of the sperm the middle-piece contracts and buds off a cytoplasmic mass containing some of the mitochondrial granules but the greater bulk of the mitochondria remains in the middle-piece and forms the sheath of the latter.

112. Acrosome-formation in Uromastix hardwickii (Gray).

BHUPINDER NATH SUD, Hoshiarpur.

The acrosome-formation in *Uromastix hardwickii* (Gray) has been worked out by the modern techniques of fixation and staining and the study of living material under the phase-contrast microscope.

In the earliest spermatid the Golgi bodies are in the form of homogeneous lipid rods and crescents, which join end to end to form a single, long rod, the acroblast. The acroblast gets closely applied to the antetrior aspect of the nucleus. Subsequently, a chromophobe material appears between the nucleus and the acroblast in association with the latter and results in the flattening of the anterior face of the nucleus. As the transformation of the spermatid proceeds, the chromophobe material associated with the acroblast is transformed into a prominent, hyaline, vacuolar, non-lipid pro-acrosome of firm consistency and concurrently the acroblast itself completely disappears. During these changes a lipid acrosomal granule is elaborated in the pro-acrosome and takes up its position in the centre of the flattened nuclear membrane.

The pro-acrosome presses on the nuclear membrane, resulting in a shallow depression. Later, the pro-acrosome expands over the anterior face of the nucleus and simultaneously the nucleus puts out a beak anteriorly underneath the pro-acrosome with the acrosomal granule seated at its tip. The nuclear beak steadily grows forward till the pro-acrosome is completely obliterated. Now the nucleus assumes a cylindrical form and concurrently the acrosomal granule grows into a conical acrosome.

113. Observations on the movements of the sperm of Hemidactylus flaviviridis Rüppell under the phase-contrast microscope.

BHUPINDER NATH SUD, Hoshiarpur.

The sperm of *Hemidactylus flaviviridis* Ruppell is a typical flagellate sperm, consisting of a conical acrosome, a long cylindrical nucleus, an elongated mitochondrial middle-piece (small in unripe sperm), and a long tail without an end-piece. The middle-piece is bounded in front and behind by a granular proximal centriole, giving rise to the axial filament, and a ring-shaped distal centriole respectively.

The maturing sperms from the testis are generally non-motile but occasionally show lateral snake-like movements of the axial filament. These movements start from the proximal centriole, and also indirectly affect the head region. The ripe sperms from the vas deferens show brisk rotatory movements, starting from tthe proximal centriole and affecting directly the head as well as the axial filament. The movements of the axial filament in the middle-piece region are very feeble and this may be due to the mitochondrial sheath. The rotatory movement of the sperm is interrupted at intervals by the sharp bending of the sperm in the region of the distal centriole and thus the sperm moves with jerks in all sorts of directions. Occasionally the sperm darts in a linear direction as a result of the rotatory movement supplemented by the lateral snake-like movement of the axial filament.

114. A study on the chromosomes of Ariophanta bistrialis Beck., A. semirugata Beck and A. ligulata Fer. (Stylommatophora : Pulmonata).

R. NATARAJAN, Annamalainagar.

The present paper is a study of the chromosomes of three species of common South Indian Pulmonates viz., *Ariophanta bistrialis A. semirugata*, and *A. ligulata*. The chromosomes of comparatively very few pulmonates, and none of the Indian forms have been investigated so far, chiefly on account of technical difficulties.

A. bistrialis has 2n=54 chromosomes all metacentrics. Of these, three pairs are larger in size than the rest which are all alike. In *A. semirugata* 2n=56 and all the chromosomes are metacentrics. Of these, four pairs are larger and one of the larger pairs has sub-median centromeres, the rest having median centromeres. *A. ligulata* has 2n=64 chromosomes all metacentrics, the highest number occurring in pulmonates. Eight of these chromosomes are larger than the rest and four of them have sub-median centromeres.

Further study is in progress.

115. The chromosomal patterns of some Opilionids (Arachnida).

M. D. PARTHASARATHY, Bangalore

The present investigation relates to the chromosomes of some American Opilionids (class Arachnida). In this study, three species of the genus *Leiobunum* (*L. crassipalpe, L. nigripes,* and *L. ventricosum*) of the family Phalangiidae were studied. All these three had a diploid number of 22 chromosomes and no sex element was observed. However in the New World form, *Vonones, ornata,* (family Cosmetidae), there were found 25 chromosomes in the diploid condition and 13 or 12 in the haploid; thus establishing the presence of a X-0 type of sex-determining mechanism in the male, hitherto unreported by previous workers in the Opilionids.

116. Catalase activity in Blepharisma (Protozoa : Ciliata).

B. R. SESHACHAR, P. B. PADMAVATHI and A. V. S. PRABHAKAR RAO, Bangalore.

The respiratory enzyme catalase is identified in an Indian species of *Blepharisma* (Protozoa : Ciliata). This enzyme is universally present in all the aerobic organisms. In a living cell the primary product of oxidation of organic matter is hydrogen peroxide which is toxic to living cells and therefore is acted upon by the 'protective enzyme' catalase. The enzyme converts hydrogen peroxide to water and molecular oxygen, the latter being utilised for respiration.

The catalase activity is estimated by the amount of hydrogen peroxide decomposed by the enzyme by titrating the residual hydrogen peroxide with potassium permanganate. For the estimation of enzyme activities the methods outlined by Sumner and Somers (1947) were followed. Experiments were designed to determine optimum conditions necessary for the maximum activity of the enzyme. From the results obtained, it could be concluded that the maximum activity of the enzyme is at neutral pH (7·0) and at 30°C. Attempts to crystallise the enzyme are being made.

117. A cytochemical study of Paramecium palycaryum.

P. C. SEN GUPTA and H. N.'RAY, Calcutta.

Paramecium polycaryum was isolated from a pond near Calcutta and maintained in culture. Cytochemical investigations carried out on wet-fixed smears and histological sections showed the folowing.

The macronucleus was made up of DNA, RNA, and protein containing tyrosine, trytophane or histidine. The micronuclei, usually 4 in number in the resting stage, showed a ring like appearance with the Feulgen reaction. It also contained ribonucleoprotein. Both the macronucleus and the micronuclei showed the presence of alkaline phosphatase.

The endoplasm was rich in RNA and glycogen in addition to simple protein. Mucopolysaccharide of hyaluronic acid type was found to be present in the body surface and the protoplasm. Lipoids were present in the body surface and the endoplasm where granules corresponding to mitochondria and the Golgi complex were also visualised by Sudan black B. Alkaline phosphatase was also present but the reaction was less intense than the nuclei.

The ectoplasm showed weak reaction for protein.

The cilia and the basal granules showed reaction for protein.

118. Glycogen content of Actinotrocha larva.

K. P. KRISHNAMURTHY, Annamalainagar.

The glycogen content of the Actinotrocha larva of *Phoronis* in three different stages of development was studied quantitatively. At the time of metamorphosis the glycogen content increases nearly thrice, and after metamorphosis, falls down again. Evidently glycogen serves as the source of energy during metamorphosis.

119. A preliminary cytochemical study of the chromatoid bodies in the male Germ-cells of reptiles.

BHUPINDER NATH SUD, Hoshiarpur.

In the spermatogenesis of *Lissemys p. punctata* Bonnaterre, *Natrix p. piscator* Schneider and *Uromastix hardwickii* (Gray) large, spherical or ovoid chromatoid bodies were recorded by the author. The chromatoid bodies in these reptilian species appear and disappear twice during spermatogenesis as whole bodies and during their existence they remain inactive, not giving any visible proof of their participation in the formation of the sperm. In the present paper a preliminary cytochemical analysis of these enigmatic bodies has been presented.

The chromatoid bodies in these reptiles take up a deep haematoxylin stain in chrome-osmium, Bouin and Carnoy preparations. They appear yellow in unstained, freshly mounted chrome-osmium preparations. They are not blackened in silver and long osmication techniques, and are not coloured at all in Sudan black. From these reactions it can be interpreted that the chromatoid bodies are not lipid in nature but may be composed of a complex of carbohydrates and proteins or proteins alone.

The chromatoid bodies take up a deep red acid fuchsin stain in Champy-Kull and Altmann preparations and this may indicate the presence of proteins. Further, the chromatoid bodies are not even slightly corroded in Bouin and Carnoy preparations, and they give a positive reaction with the mercuric bromophenol blue technique, which is specific for proteins.

120. Studies on the vitamin-C in the oocytes of carps.

H. S. CHAUDHURY, Naini Tal.

Since the first cytochemical demonstration of the vitamin C in the animal cells by Szent-Gyorgi in 1928, its presence and localisation has been reported in many animals. In the present paper the presence of vitamin C has been demonstrated in the oocytes of some local Carps The ascorbic acid in these eggs appears very clearly in the oogonial stage as a few black granules of silver in the juxtanuclear position following Bourn's (1941) technique. From this position it migrates round the nuclear membrane before getting dispersed in the general cytoplasm. The localisation of the vitamin C and its association with the mitochondria has also been discussed.

121. Occurrence of mitosis in the Reacting system of secondary organiser.

SIVATOSH MOOKERJEE and K. BALASUBRAMANIAM, Calcutta.

Presumably, the organiser-action includes many cellular events and how far active mitosis is related to it, is least known. Studies have been undertaken to understand the phenomenon of mitosis in a reacting system of the organiser material and the competent tissue at the crucial event of an induction. The secondary organiser material in chick has been taken up to study the incidence of mitosis thereon. It is interesting that throughout the process of secondary organiser action, mitosis occurs both in the cells of the presumptive cup and the lens placode. In fact, the lens ectoderm begins from two-layer cell-thick in 30-hour embryo and becomes gradually thickened to four-cell-deep to become future lentoid tissue in 60-hour embryo. Necessarily, such an increase of cell layers is an outcome of mitosis. However, from the beginning of the induction phenomenon, till its completion, it is found that the surface of the future lens and cup region which are in close apposition is not involved in active mitosis. Mitosis occurs only in the cells of those two reacting tissues which are away from the points of inducing surface. The study shows that the reacting system of secondary induction may involve many other changes but its point of interaction is not a centre of active mitosis.

122. A study of chromosomes durnig spermatogenesis in Viviparus dissimilis (Muller) and Viviparus bengalensis (Lamarck). (Prosobranchia—Gastropoda).

K. RAMAMOORTHY, Annamalainagar.

The chromosomes of only six species of *Viviparus* have been investigated so far, but none of them is Indian species. The present account relates to the number, morphology and behaviour of the chromosomes during spermatogenesis in *Viviparus dissimilis* and *Viviparus bengalensis.*

In both the forms the number of chromosomes is 2n=22. All the chromosomes are metacentrics. In *Viviparus dissimilis* one pair of chromosomes has submedian centromeres but in the other forms two pairs are seen with submedian centromeres. The chiasma frequency is slightly higher in *Viviparus bengalensis* than in *Viviparus dissimilis.*

123. Spermatogenesis of the honey-bee, Apis indica.

G. P. SHARMA and C. G. KUMBKARNI, Hoshiarpur.

To the best of our knowledge there is no reference in literature regarding such important cytoplasmic inclusions as the Golgi elements and the mitochondria in the male germ cells of the honey-bee. Consequently in the present work the morphology, chemical nature and the role of these inclusion have been completely worked out with the most modern techniques. Observations were made on the living—(under the phase-contrast microscope), and the fixed-testicular material obtained from the larvae and pupae of the developing drones of the honey-bee, *Apis indica.* The fixatives employed were F.W.A., Champy, Sanfelice and Helly's fluids. The sections were mainly stained with 0·5% iron haematoxylin, but Sudan-black technique was also employed.

Since the drones of the honey-bee are the result of a parthenogenetic development, they receive only the haploid set of sixteen chromosomes. To avoid a further reduction in the number of chromosomes, the first meiotic division is abortive. The nucleus of the primary spermatocyte does not divide into two, but a bud is given off from its cytoplasm. A discrete spherical body of proteinous nature which has been lying in the cytoplasm is also sloughed off along with this bud. The second meiotic division is a normal mitosis, but it is highly unequal regarding the cytoplasm. This results in the formation of a small spermatid body and a large mail spermatid. Only the latter matures into a sperm, while the former degenerates. Whereas the Golgi elements during spermatogenesis are in the form of Sudanophilic granules, and completely or incompletely ensheathed duplex spheres, the mitochondria are observed as slightly sudanophilic fine threads, thick filaments, loops and vesicles. The mitochondrial threads possess tip granules quite similar to Hirsch's Golgi-pre-substance. One of the Golgi spheroids, the acroblast, secretes the acrosome, while the remaining ones are sloughed off. The mitochondrial nebenkern is of the 'plate-work' type and the tail-sheath is formed by the 'sheath-substance' arising in it.

124. A study of the nucleus during spermiogenesis in grasshopper with the electron mncroscope.

C. M. S. DASS and HANS RIS, Madison.

A study of the submicroscopic organisation of the nucleus during spermiogenesis in grasshoppers *Chortophaga viridifasciata* (De Geer), *Chorthippus curtipennis* (Harris) and *Romalea microptera* (Beavois) has revealed that in early spermatids, as in other interphase nuclei, the chromosomes consist of microfibrils 200 Å thick, which in turn made of two sub-units of 100 Å. As spermiogenesis advances the arrangement of microfibrils becomes more regular and they orientate more or less parallel to the long axis of the elongating sperm nucleus. The individual microfibrils, at this stage, are 100—150 Å thick and in places appear to separate into finer fibrils of about 50 Å. With further elongation of the spermatid nucleus the 50 Å fibrils arrange close to each other to form membranes. These run in an irregular undulating manner in the nucleus, and are organized in pairs about 100 Å apart. The membranes become stretched and closely packed as the elongation of the sperm nucleus progresses until finally the nucleus in the mature sperm is uniformly electron dense. A corresponding cytochemical study of the process indicate that the 50 Å unit fibrils become discernable at a time when the change-over from histone to protamine and disappearance of the non-basic proteins take place in the spermatid nucleus.

125. Enzymatic activity of ribonuclease after fixation.

K. K., NAIR, Bombay.

The basophilia observed after Unna staining in sections of cells or tissues which were treated with Rnase in *vivo* or *vibro* is very often attributed to the loss in RNA as a result of enzymatic digestion. In the case of the oocytes of Star fish fixed by freeze-substitution it was observed that cytoplasmic basophilia disappeared even though the oocytes were treated only for five minutes in Rnase solution. But biochemical estimations did not show any decrease in the RNA content. There was no loss in basophilia when the oocytes were fixed in Zenker. To see whether the loss in basophilia observed after freeze-substitution was due to the fact that the Rnase present in the cells did not lose its enzymatic activity and it digested the RNA from the cells when sections were hydrated for spreading, a series of experiments were conducted. Known concentrations of Rnase solutions were mixed with fixatives like Serra, Acetic acid—alcohol and Zenker. After dialysis the enzymatic activity of these solutions were determined. The results indicate that Rnase activity is completely destroyed after fixation in Zenker while it is retained in the other solutions treated with Serra and acetic acid alcohol.

126. Heterogamety in Gasterosteus aculeatus.

H. SWARUP, Saugor.

Triploid specimens of *Gasterosteus aculeatus* were produced experimentally by the author at the Zoological Laboratories of the University of Oxford. Triploid males produced normal looking testes, though in these the sperms were fewer and larger in size. The triploid females, however, showed only ovotestes with few ova, and thus the experimentally produced triploids could never breed.

The above observations point to the fact that in *G. aculeatus,* the female is heterogametic, while the male is homogametic. In the triploid generation, the super-females which should have been also found theoretically, were absent and this was due to the fact that in this fish such a combination of sex-chromosomes probably produces a lethal effect.

127. The hybrids of Clarias and Heteropneustes.

L. S. RAMASWAMI, Bangalore.

Fertilization of *Clarias* eggs with *Heteropneustes* sperms and reciprocal crossing has been done. In the *Clarias* ♀ X *Heteropneustes* ♂ hybrids, the head region shows only the otic vesicles and the tubular heart starts functioning after some time. The morphogenesis at intervals of 24 hours has been followed and after three days the hybrid fry show poorly developed barbels, branchial arches and opercula. The mouth opening is seen but does not function as in the normal ones. In the *Heteropneustes* ♀ X *Clarias* ♂ hybrids, the morphogenesis is almost similar to the normal ones; the hybrids lack one or two barbels. Whether these hybrids have the normal nuclear constitution or they are merely examples of gynogenesis is being examined.

128. Influence of breeds and season on the sexual functioning of bulls.

R. B. SINGH and K. Q. HUSSAIN, Mathura.

In this study data of 105 Murrahs, 84 Hariana and 31 Sahiwals, located at various Artificial insemination centres in U.P., regarding their ability to donate semen were collected. Efforts were made to collect semen twice a week from each of the bulls throughout the year. The sexual 'behaviour of the bull was marked as functional, if the bull was donating semen twice a week.

Analysis of the data indicates that an overall percentage of functioning Murrahs comes to 75·08; of Hariana 60·08; and of Sahiwal 52·07 in the year. Murrahs are, therefore, better in donating semen than Harianas and Sahiwals. Season has great influence on the sexual behaviour of bulls. For Murrahs the period covering August to February is the best in which 89·34% of the bulls are very active in donating semen. During March the peak period starts declining as 71·42% of the bulls function properly and the rest are non-functioning or partially functioning. The months of April, May and June are the worst for this breed as collections can be made regularly from only 47·32% of the bulls. They start getting better during July, soon after the rains, when 61·61% of this breed become vigorous in giving semen.

Though the overall percentage of sexual functioning Hariana is lower than the Murrahs, it is less influenced by the season than the other. The best months for this breed are March to July when 68·50% of the bulls are sexually active. During August when the humidity and flies increase the figure goes down to 59·52%. The worst season is the period covering September to January when only 52·68% of the bulls of this breed donate semen. During February the position starts improving as the percentage goes upto 58·57.

The season does not seem to influence the sexual activity of Sahiwal bulls as the difference between the percentage of the functioning and non-functioning animals in different seasons is not statistically significant. It may also be due to the fact that a small number of the bulls of this breed was available for this experiment.

129. Active principles of egg yolk as buffer for ram semen.

SURENDER KUMAR and S. K. SAHA, Mathura.

Various dilutors like egg yolk citrate, egg yolk glycine, mixture of egg yolk sodium citrate and glycine etc., are in use for the preservation of ram semen used for Artificial Insemination. Fresh egg yolk comprises the principal component of all the dilutors used. In the interior of hills the procurement of fresh egg is a serious problem. Efforts were, therefore, made to find out some dilutors, with the active principle of egg yolk, which can replace the use of fresh egg and can be stored for longer period.

The active principle was isolated by first precipitating the protein portion in egg yolk by the addition of acetone and subsequent washing with acetone to remove the greater portions of lipids. The yellowish precipitate was dried to make it acetone free and afterwards extracted with a mixture buffer (1·8 gm. sodium citrate and 2 gm. glycine per 100 c.c. of distilled water) and also with Sorenson's phosphate buffer and then followed by centrifuging and subsequent filtration of the buffer extract to remove the insoluble material. The buffer containing the active principle before use was stored for 8 days.

Six good quality semen ejaculates from rams of Bikaneri breed were preserved in the solution of the active principle in the ratio of 1 : 25. Mixtures of egg yolk sodium citrate and glycine and also the egg yolk phosphate were used as controls.

The mean half average life (number of days in which semen sample can be used for insemination purpose) was 6·3 days in the solution of the active principle extracted with the mixture of sodium citrate and glycine and 2·7 days when extracted with Sorenson's buffer. In the controls the mean half average life was 7 days in the mixture of egg yolk sodium citrate and glycine and 2·8 days in egg yolk phosphate. The full average life was 12·5 days in the solution of active principle extracted by mixture buffer, and 4·5 in the solution of active principle extracted by Sorenson's buffer, whereas in the control, the full average life was 12 days in mixture of egg yolk citrate and glycine and 5·5 days in egg yolk phosphate.

The results show that there is very little difference in the use of fresh egg and extract by mixture buffer prepared from the active principle. Thus active principle can be used in place of fresh eggs.

130. The origin and development of mesoderm in Achatina fulica.

KRISHNA CHANDRA GHOSE, Calcutta.

During the late nineteenth and the beginning of the twentieth century it was established that in mollusces the mesoderm mother cell (4d) appears from the macromere 3D. In the middle of the second quarter of the current century, it has been very strongly asserted that the mesoderm mother cell is a descendant of the macromere 4D.

In *Achatina,* the mesoderm mother cell (4d) arises from 3D and this supports the older view. In the 36-cell stage, the four macromeres 3A-3D occupy the vegetal pole of the embryo and the cell 3D undergoes an unequal division producing a large 4d and a small 4D. At the 37-cell stage, the vegetal pole is occupied by five cells 3A-3c, 4d and 4D. The cell 4d subsequently migrates into the blastocoele and the pole again becomes made of four cells 3A-3c and 4D.

Before the commencement of gastrulation the inactive 4d cell lies immediately anterior to the point of investigation. With the beginning of gastrulation, the cell 4d divides itself into two primary mesoderm cells, which are pushed to either side by the invaginating endoderm. The mesoderm cells produced from the mother cells arrange themselves in files in between the ectoderm and endoderm. Subsequently the cells divide themselves in both the directions and the mesoderm bands increase both in length and breadth.

131. Late development of the vertebral column in the Indian five-striped squirrel, Funumbulus pennanti Wronghton.

GITIKA DATTAGUPTA, Pilani.

Since the bones of the five-striped squirrel, *Funumbulus pennanti* Wrongton, present avian condition, the later stages of development of vertebral column have been studied with a view to finding out whether or not there is any parallelism in their modes of development. The centrum is formed from two concentric perichordal tubes. The neural arch is derived from the interdorsals, basidorsals and supradorsals. The zygapophyses are formed by outgrowths of the basidorsals. The neural spine has three elements, the anterior and the posterior portions arising from the neural arch and the cartilaginous portion from the supradorsals. The pro-atlas lying between the skull and the atlas, fuses with the atlas. The centrum of the atlas fuses with that of the axis and form the odontoid process.

The degeneration of the cartilaginous model and the formation of the membrane bone is similar in all the bones studied. Migratory connective tissue cells from myotomes come and plaster over the cartilaginous model, and ultimately ossify to form membrane bone. Simultaneously, the cartilaginous tissue degenerates. Similar modes of degeneration of cartilaginous model and formation of membrane bone, which are found only in the birds, have not been reported in any mammal.

132. The chondrocranium of the Indian gerbille, Tatera indica cuvieri (Waterhouse).

K. M. KADAM, Bangalore.

The chondrocranium of a 9·0 mm. (head-length) embryo of *Tatera* has been described and compared with that of *Lepus* (de Beer 1930). It is observed that the chondrocranium of *Tatera* differs in many important features from that of *Lepus* and some of these features are stated as being primitive by de Beer (1930) and are also met with in Primates. The gerbille differs from the rabbit in, (1) the absence of isolated nodules of cartilage in the side wall of the skull described by Voit (1909) in *Lepus,* (2) absence of a ala hypochiasmatica, an interorbital septum, a mastoid process and (3) in the absence of the continuity between the anterior and posterior lamine transversalis by means of paraseptal cartilages. While there are two pairs of hypoglossal foramina in the rabbit there is only a pair in the gerbille. The only point of similarity in the primitive features of rodents mentioned by de Beer (1930) is the presence of a paracondylar process in the gerbille. And also, the chrondrocranium of *Tatera* does not possess the features that are common between Primates and Rodents as enumerated by de Beer. On the other hand the features such as, the incompleteness of the paraseptal cartilages, absence of a mastoid process and ala hypochiasmata are shared with those of another Primate, *Loris* (Ramaswami 1957).

133. Development of the skull in Catfishes. Part IV. The development of chondrocranium in Arius jella Day (Ariidae) and Plotosus canius Ham. (Plotosidae) with an account of their inter-relationships.

H. R. SRINIVASACHAR, Bangalore.

This paper deals with the development of chondrocranium in two stages (10 mm., and 29·0 mm.) of *Arius* and one stage (16 mm.) of *Plotosus*. In the earlier papers (Srinivasachar 1957a, 1957b, 1957c) the author has described the development of the chondrocranium in some members of the four siluroid families Schilbeidae, Bagridae, Heteropneustidae and Clariidae with a view to assess the usefulness of chondrocranial characters in a revision of the systematics of the group.

In the 10 mm. stage of *Arius* the trabeculae have united anteriorly by a thin trabecular commissure. The orbital cartilages are anteriorly free and are not connected with the ethmoid region. The notochord projects into the hypophysial fenestra and the rudiments of the occipital arches could be made out behind the auditory capsules. In the visceral arch skeleton the pterygoid process is still not developed. All the five branchial arches are developed. The chondrocranium is fully formed in the 29 mm. stage. The lamina precerebralis is developed and extends posteriorly as the thin nasal septum. The solum nasi forming the floor for the nasal sac is much reduced. The lamina orbitonasalis possesses three foramina for the passage of the profundus and superficial branches of the trigeminal nerve and a blood vessel. The orbital cartilages are masstive plate-like and have united with the laminae orbitonasalis. In the visceral arch skeleton the pterygoid process is continuous with the quadrate which is fused with the hyomandibula.

In the 16 mm. stage of *Plotosus* the chondrocranium is fully formed and exhibits a number of primitive features. The solum nasi is completely absent. In the visceral arch skeleton the ptreygoid process is independent of the quadrate. Meckel's cartilages are fused anteriorly. In the branchial arches the pharyngobranches of the second, third and fourth arches are fused and the pharyngobranch of the first arch is free.

The inter-relationships between these members and the other members of the siluroids studied have been discussed in the paper.

134. Eggs of Aryzias melastigma (McClelland) as suitable material for studies in experimental embryology.

K. RANGARAJAN, Annamalainagar.

In the course of a study of the embryology of *Oryzias melastigma*, the author has explored the suitability of the eggs for experimental investigations. The results obtained so far have been very promising.

Magnesium chloride solution was used for inducing twinning of embryos of *Oryzias*. The best results were obtained with solutions of 14/60 M. $MgCl_2$. Solutions of lower concentrations than 9/60 M. $MgCl_2$ had no perceptible effect, and solutions with higher concentration than 14/60 M. $MgCl_2$ had toxic effects.

Tap-water to which HCl was added to alter the pH to 5·7 induced cyclopea in the embryos. Lithium chloride acted as a deterrant on eye development, suppressing the optic rudiments in some cases and inducing abnormalities in others.

135. Chemical embryology of *Pila virens* (Lamarck).

K. RAMAMOORTHY, Annamalainagar.

1. Representative stages in the development of *Pila virens* from the fertilized egg to hatching have been investigated with reference to (a) localisation of cytoplasmic granules, ribonucleic acid and alkaline phosphatase, (b) quantitative distribution of glycogen and calcium, (c) respiratory quotient, (d) free and protein-bound amino acids in the embryos.

2. The Beta granules are localised at the vegetative pole and later in the endoderm cells, the Alpha granules in the animal pole and later together with a few Beta granules in the ectodermal cells.

3. Alkaline phosphatase activity increases at gastrulation.

4. The glycogen content of the embryo is at its height in the trochophore and early veliger stages.

5. Ribonucleic acid is greater during gastrulation.

6. The calcium content increases with the progress of development.

7. *Free amino acids* :—Hydroxyproline occurs only in 2-celled stage. Leucine, Isoleucine, Phenylalanine appear on 3rd day, Valine and Methionine on 4th day, Tyrosine on 7th day, as pigmentation becomes evident, and trace of Proline before hatching. Threonine, Glutamic acid, Alanine, Glycine, Serine and Aspartic acid are present throughout development.

8. *Protein bound* :—Glutamic acid and Glycine are present in all stages. Hydroxyproline is present only in two-celled stage. On the 3rd day, with the formation of organ rudiments, several amino acids appear. Tyrosine, Phenylalanine and Asparagine appear on 4th, 6th and 8th days respectively.

136. The mitotic field in relation to morphogenetic movement in Chick embryo.

SIVATOSH MOOKERJEE and S. ADHIKARI, Calcutta.

There are mainly two important happenings in the phenomenon of gastrulation. They are cell-migration and cell-multiplication. In order to correlate these two factors, extensive mitotic counts of the gastrulating cells in chick embryo have been made. The sequence and location of mitosis were observed in the field of blastoderm of 0, 6, 12, 18 and 24 hr. old embryos, and histograms were made to correlate the site of mitosis. It has been observed that the largest incidence of mitosis occurs on the sites of the active morphogenetic movement. That is, in the initial stage of gastrulation posterior part of the blastoderm, where active lateral cell movements are under way, has also been the centre of highest mitotic activity. During the second phase of gastrulation, viz. in the mid-gastrulation, when forward morphogenetic movement of cells takes place, the count of mitotic division is at the highest at this region. In the last phase of gastrulation, when the posterior migration of cells occurs largest number of cell divisions take place in this region. These results show that in case of chick gastrulation, morphogenetic movement is also accompanied by active cell-increase.

137. On the afuna of the coconut husk retting grounds.

C. V. KURIAN, Cochin.

Retting of coconut husk is carried out on a large scale in the coastal regions of the brackish water lakes of Travancore-Cochin. The retting grounds may be easily demarcated by the smell of hydrogen sulphide and the yellowish colour of the water. Free sulphur precipitated may also be seen as a white scum at the surface of the water.

Owing to the adverse conditions in the retting grounds the distribution of the fauna in this region is very peculiar. But, during the rainy seasons there is much washing out and the toxic effect of the water is nullified. There is a regular cycle of changes in the fauna of this region in accordance with the changes in salinity, depletion of oxygen, presence of suspended impurities and other adverse factors, the fauna being at its minimum during the months March to May, when there is no admixture of fresh water.

Among fishes only *Macropodus cupanus* is found to thrive in the retting grounds during all the seasons. Rarely *Aplocheilus lineatus* is also observed at the surface of the water. Towards regions of less toxicity *Megalops cyprinoides, Etroplus suratensis, E. maculatus, Tilapia mossambica, Gerres punctatus* and *Macrones gullo* are met with. But mullets and milk fish appear only when the water is fresh, by the time the toxicity of the water has been completely washed away.

Fouling organisms are absent in the retting grounds and wooden planks kept immersed in retting water even for two years are found to be devoid of any borers, while similar planks kept in the adjoining regions of the lake are severely attacked by *Martesia striata* and *Teredo sp.* within three months and completely spoiled by the end of the first year. Detailed experiments to determine the preservative quality of retting water against fouling organisms and borers are being carried out. The fauna as well as the water of the retting grounds are being studied in detail.

138. Notes on the distribution and seasonal variations of marine wood borers of the Madras area.

A. DANIEL, Madras.

The different members of the animal community which bore into timber in the Madras area, are commented on. The most important borers are, the Pholadids, *Martesia striata* and *Martesia fragilis,* the Terendinids, *Bankia indica, Teredo madrasensis, Teredo clava, Teredo furcillatus, Teredo parksi,* and the isopod *Sphaeroma vastator.*

The timber requirements of the area and the destruction caused by these borers at various sites, are examined. The numbers of different species of borers settling and boring on wooden test panels are recorded from time to time, during the year the experiments were performed and their variations in the different months noted.

The presence of micro-organisms which have to condition wood before further attack by wood borers can take place is discussed.

The difference in the results obtained at different sites are discussed with reference to ecological conditions.

139. Settlement of marine foulers and borers in the Madras harbour in relation to velocity of water currents.

A. DANIEL, Madras.

Experiments were conducted in order to determine the effects of water currents upon the intensity of attack of the foulers, *Balanus amphitrite, Hydroides norvegica* and borers *Martesia striata, Bankia indica* and *Teredo* spp.

A wooden disc was rotated at variable speeds to provide increasing rates of water flow.

The limiting velocity range for (a) *Balanus amphitrite* is 0·6—1·08 knots (b) *Hydroides norvegica* is 0·9—1·2 knots (c) *Martesia striata* is 1·3—1'5 knots and (d) *Bankia indica* & *Teredo* spp. is 1·8 knots.

The differences in the limiting velocities of different organisms is attributed to the different "attachment mechanisms" adopted. It is suggested that in special situations where antifouling and antiboring preservatives could not be used, settlement could be prevented by strong artificial water currents,

140. Seasonal changes in the 'Total Biomass' and 'Total Organic Matter' of plankton in the marine zone of Veller estuary (Madras State).

B. SESHADRI, Annamalainagar.

The paper records the seasonal changes observed during June 1953 to July 1954 in the 'total biomass' and 'total organic matter' in relation to hydrological features in the marine zone of the Vellar Estuary.

During July, August and September the values for total biomass and total organic matter were very low, being below 800 gms. and 500 gms. per cubic meter respectively. From December onwards the values for both rose, reaching in May a peak of 4227·6 gms. per cubic meter for total biomass and 3805·4 gms. per cubic meter for total organic matter. After May there was a fall in the biomass and total organic matter.

Both total biomass and total organic matter show inverse relation to the phosphate content of the water.

The significance of these observations is discussed.

141. Observations on the tidal cycle in the Vellar Estuary.

K. RANGARAJAN, Annamalainagar.

The biological and hydrological changes in the gradient zone of the Vellar Estuary during one complete tidal cycle have been studied every two hours at full moon and new moon for about a year. The tide is semi-diurnal with two high waters and two low waters. The maximum tidal range record is 3′ 6″.

The range of variation in the surface temperature during one tidal cycle is 3·6°C. The thermal stratification which is developed during the early part of the tidal cycle is short-lived, being destroyed at the commencement of the second high water occurring in the evening.

Oxygen concentration of surface waters follows closely the temperature cycle.

Salinity changes closely follow the tidal cycle. Bottom salinity is higher than surface salinity and a pronounced chlorinity conflict is established in the estuary at the time of low waters.

The maximum oxygen concentration is at 4 p.p.m. The bottom has a lower oxygen concentration, the difference being 2·0 p.p.m.

The plankton is richer at night and this is not due to the influx of neritic element. Organisms including adult crustaceans, decapod larvae, veligers etc., from subsurface waters migrate up and swarm at nights,

142. Observations on the hydrological conditions in the surface waters of the North Kanara Coast : I. Karwar Bay, Binge Bay and Kali river.

S. RAMAMURTHY, Karwar.

Mackerel fishery, constituted by *Rastrelliger kanagurta* (Cuv.) is of commercial importance in the North Kanara coast. The present paper is part of a comprehensive scheme of investigations on the plankton and hydrology in relation to the mackerel fishery of this coast. The different factors discussed here, viz. temperature, alkalinity, pH, salinity, dissolved oxygen, phosphates, nitrites and silicates show definite seasonal cycle due to the influence of the south-west monsoon. The Karwar Bay is profoundly affected by the Kali river which opens into the Bay and it is only the Binge Bay which maintains a marine environment during monsoon.

Lowering of temperature, alkalinity, pH, and salinity and increase in dissolved oxygen, phosphates, nitrites and silicates are characteristic of the monsoon period, save in Karwar Bay where phosphates and nitrites are low due to dilution effect. The increase in phosphates and nitrites may possibly be due to the intense agitation of the water column which replenishes the surface layers as noticed in the Malabar coast. The silicate rise is due to the influx of river water and run-off from the land.

A comparative study of the distribution of inorganic phosphates in the surface waters of the Indian coast shows that the values at Karwar and Calicut, comparable to each other, are higher than those observed at any other place. This is suggestive of the higher level of organic production in these two areas on the West Coast which obviously supports a rich fishery.

143. Plankton studies . 1. A quantitative study of the plankton production in relation to the hydrographical conditions off Waltair.

P. N. GANAPATI and D. V. SUBBA RAO, Waltair.

The paper presents results of observations on the hydrographical and planktological conditions of the surface waters at a fixed station located beyond the 10 fathom line in Lawson's Bay off Waltair during the year 1956.

The phytoplankton exhibits two peaks—a major one during March-April and a minor one during October-November. There was a wide difference in the composition of the plankton during the two peak periods. The diatom and dinoflagellate maxima coincided with one another. The major Zooplankton peak coincided with the major phytoplankton bloom while the minor one preceded the minor phytoplankton bloom.

Quantitative observations per cubic meter of sea water have shown that the plankton volume varied from 6·25 cc. during September to 194·163 cc. during October. Pigment extraction with three different solvents was attempted and the monthly average values ranged from 66·5 to 8425·6 Harvey units during December and April respectively. Ethyl alcohol benzene mixture has proved to be a better solvent for pigment extraction than Acetone and Methyl alcohol. The total biomass ranged between 0·12348 gms. during January to 3·32208 gms. during May and the total organic matter from 0·028304 gms. to 0·711874 gms. during January and February respectively.

The succession of phytoplankton blooms and the plankton production in relation to currents and hydrographical conditions on the East Coast of India have been discussed.

From the considerations of the magnitude of the standing crop and the factors governing the production the period January-June appears to be more favourable for plankton production than the other half of the year.

144. "An account of chittnophilic marine dentrifying bacteria from Pearl Oysters and Chanks."

A. SREENIVASAN, Bhavanisagar.

Seawater, off Tuticorin did not contain any chitin-utilizing Bacteria, but marine off-shore sand carried such cultures. A rich flora of chitin digesting bacteria was present on pearl oysters and chanks. Good growth of these was obtained on mineral salts-chitin broth, some showing beautiful yellow pigmentation on chitin strips. All the cultures described also liberated gaseous nitrogen from nitrates. Except one all the cultures lost the chitin digesting property on prolonged laboratory cultivation in organic media. This exceptional culture produced greenish fluorescent, soluble pigment on storage in refrigerator.

Utilisation of salts of simple organic acids of ammonium sulphate, potassium nitrate, glucose etc., as sources of carbon or nitrogen has been studied. All are 'Marine' bacteria failing to grow in freshwater media.

145. The occurrence of paracolon bacterial in tropical environment.

A. SRINIVASAN and R. VENKATARAMAN, Kozhikode.

"Coliform" organisms fermenting lactose with production of acid and gas in 24-48 hours are recognized to be of sanitary significance throughout the world. But the "Aberrant coliforms" which ferment lactose slowly or not at all but produce gas from dextrose and other sugars do not seem to have attracted any attention in India, though they are considered to be of great aetiological significance in other countries like U.S.A. This non-recognition has led to some workers (Sen and Dut 1955) misclassifying these "Aberrant coliforms" which should rightly belong to *Paracolobactrum* in other genera like *Eacherichie* and *Aerobacter*. Lactose fermentation (aerogenic) is a fundamental characteristic which should not be overlooked when classifying an organism in the genera *Escherichia* or *Acrobacter*. Characteristics of a number of slow or non-lactose fermenting *Paracolo bactrum* species isolated from mussesls are given in the paper. Among non-lactose fermenting but dextrose (Aerogenic) fermenting cultures, the peritrichous organisms should belong to *Paracolobactrum* Stuart and Borman, while the polar flagellated ones should be included in *Aeromonas* Khyver and Van Niel.

146. A simple technique for staining bacterial spores in animal tissue.

M. MUTHU and S. K. MAJUMDER, Mysore.

Staining techniques for micro-organisms in histopathological work are available. But staining of bacterial spores in animal host tissues has not been attempted so far due to the difficulty in staining the spores witthout changing the host tissue.

The staining of spores of *Bacillus cereus* var. *thuringiensis* a sporulating pathogen on *Heliothis obsoleta* F. has been attempted on paraffin sections of the diseased caterpillars. The following schedule is recommended.

Stain 16 hours in 5% aqueous malachite green at R.T. or for 4 hours at 60°C→ wash in water→stain 10-15 seconds in 0·5% aqueous safranin O→wash in water →dehydrate in acetone→dip in acetone-xylol (50 : 50) clear in xylol→mount in balsam.

Endospores take a light stain and liberated spores take a deep green stain. Bacterial vegetative cells and host tissues take a light pink stain of safranin.

147. Mitotic activity in Chick Mesonephros.

S. MITRA, Calcutta.

To account for the rate of mitosis in an embryonic development of kidney, incidence of cell divisions in the Feulgen preparations of mesonephric tubules is observed per square area of the optical field in 10 days, 12 days, 17 days and 18 days sections of embryo. Incidence of mitosis in mesonephric tubules shows the following rate of cell multiplication per 16 square units:

Mesonephric tubules of 10 days = average 7 Mitoses.
12 ,, = ,, 6
17 ,, = ,, 2
18 ,, = ,, 1

The trend of negative mitotic activity and post embryonic function of the tissue have been discussed.

SECTION OF ANTHROPOLOGY AND ARCHAEOLOGY

President :—DR. G. M. KURULKAR.

Abstracts

I. PHYSICAL ANTHROPOLOGY.

(a) Anthropometry.

1. Estimation of the height of an individual from the length of radius and ulna.

M. C. ATHAWALE, Poona.

In medico-legal cases, the estimation of the height of the deceased from his long bones forms an important evidence in the court of law. Various formulæ have been derived by different workers in the other countries like America, France, Finland, Germany, etc. In India Capt. Natt and Pan have studied the same problems in U.P. and Bengal. All these formulæ give incorrect results when used for Maharashtriyan population.

An attempt has been made to derive a regression formula for stature in relation to the radius and ulna of an individual. The material consists of 100 adult males from various parts of Maharashtra belonging to Marathas, Harijans and allied castes. Only those between 25 and 30 years were chosen. The exact height and length of the upper limbs of each case was recorded.

Average stature was	...	...	163·13 cms. ± 0·63
Average upper limb was	...	...	72·79 cms. ± 0·32

Both the forearms were X-rayed, keeping the fixed distances and fixed positions of the forearms. The X-ray measurements of radius and ulna were shown to correspond with the actual measurements of the wet bones in the cadavers.

Average radius was	...	...	25·05 cms. ± 0·03
Average ulna was ...	...	...	26·79 cms. ± 0·041

The average shrinkage due to drying was calculated to be 0·14 cms. ± 0·017 for radius and 0·1286 cms. ± 0·0192 for ulna.

The ready reckoner gives probable height for a particular value of radius or ulna.

2. Determination of the Upper Limit of Femur by X-ray Pictures.

K. D. DESAI, Bombay.

Accurate measurements of the lengths of femora and lower limbs are required for clinical purposes, anthropological investigations, and observations on normal growth changes. To measure the length of the femur or lower limb, easily felt bony points like the anterior superior iliac spine, or greater trochanter are usually chosen for representing the upper limit of the femur or lower limb. But this is not an accurate procedure. First, it is essential to correlate the actual uppermost point on the femur to the easily felt bony points in the vicinity. Harris Wilder has suggested a formula to determine the uppermost point of the femur. The object of this study is, to see whether this formula will suit the Indians or whether it should be modified.

For this purpose, X-ray pictures of lower limb including pelvis of adult males between the ages of 25-30 years were taken. For control a scale was placed by the side of the lower limb, which came in the picture. From these pictures, it is expected that it will be possible to determine exactly the relationship of the uppermost point on the femur to the anterior iliac spine and the pubic tubercle.

(b) Dermatoglyphics.

3. Dermatoglyphics of Kurmi Mahatos—Manbhum District.

MANISH CHAKRAVARTTI, Calcutta.

The present paper deals with the detailed analysis of the finger and palm prints of the Kurmi Mahatos. Besides the three main finger print patterns, have also been calculated, the comparative occurrence of whorls and loops in different digits with ratio, indices, monomorhic hands, symmetry and asymmetry, actual frequency and chance frequency, the pair group rule and the gene frequency.

The palm examination includes the frequency of different palm main lines, endings, hypothenar and thenar patterns, patterns on the inter-digital areas and the axial triradii.

4. Finger prints of the Pati Rabhas.

BHUBAN M. DAS, Gauhati.

The paper deals with the detailed analysis of the finger print patterns of 108 male and 100 female Pati Rabhas. The data was collected in the month of December, 1955, from Goalpara district in Assam. The three main finger patterns *viz.*, whorl, loop (radial and ulnar) and arch have been identified for classification. The following indices have also been calculated from the frequencies of the above three patterns: Dankmeijer's Index, Pattern Intensity Index and Furuhata's Index. The two bimanuars of the two sexes have also been constructed to represent the trifold pattern (Whorl, loop and arch) of the finger prints. Poll's "Pair Group Rule" formula has also been applied.

5. Palmar Prints of the Sindhi Khatris.

INDERA P. SINGH and H. K. KUMBHANI, Delhi.

178 Palmar Prints of 89 individuals were collected from Sindhi Khatri School children at Delhi. The Palmar prints have been analysed according to methods suggested by Cumins and Midlo.

The total number of Wilder's 'Main Line Formulae is 52. The percentage frequencies of three principal Main Line Formulae 11.9.7—, 9.7.5.—, 7.5.5.— are 36·4, 5·0 and 8·1 respectively. Wilder's Modal types have also been calculated and found to be 62·3, 18·0 and 19·5 per cent respectively. The frequency of Modal type 11 is similar to Modal types of European, Brahmins, and Rajputs of Northern India. They are significantly different from Mongoloid groups since they show a very low frequency of Modal type 9 and 7.

The percentage frequency of loops on Hypothenar area is 19·8%. They are more frequent on male palms than the female palms.

The percentage frequency of occurrence of pattern loop on Thenar Ist interdigital is 14·6 and is similar to Indians (Biswas), Indians (Collins), and Rajputs of Kulu.

The percentage frequencies of three interdigital configurations *viz.* O.O.O., O.O.L. and O.L.O. is 17·5, 14·0 and 36·8, respectively. They resemble in this respect the Brahmins, Rajputs, and Kotlas of Northern India.

6. Finger Dermatoglyphics of Sindhi Khatris.

INDERA P. SINGH and H. K. KUMBHANI, Delhi.

This study reports the analysis of Finger-ball patterns of Sindhi Khatris. 900 Finger prints of 90 individuals—50 females and 40 males were collected. Methods used for analysing the data are according to Geipel.

55 different combinations of patterns were noticed on their fingers. The most frequent combinations were WWWWW(24) and UUUUU(24). The combination WWWWW is most common on the right hands and UUUUU most frequent on the left.

The percentage frequency of whorls, loops and Arches is 39·2%, 54·4% and 6·3%, respectively.

Pattern intensity index, Furuhata's index and Dankmeijer index have been calculated and are found to be 13·23, 72·06 and 36·12, respectively.

The Sindhi Khatris according to Whorl-Loop-Arch Frequency, pattern intensity index and Dankmeijer index are similar to European groups as well as other North Indian groups.

The percentage distribution of Bonnevie's genotypes are as follows :—vv,Vv,VV are 51·5%, 38·5%, and 10·0% respectively; rr, Rr, RR and 6·2%, 51·5%, and 42·2% respectively; uu, Uu, UU are 11·0%, 52·7% and 36·2% respectively. The females do not show any fingers with thick epidermis although 20% males show it. The absence of cushioning both on radial and ulnar side among Sindhi Khatris is very great.

(c) Hair forms.

7. Hair Form in some Indian Aborigines.

A. R. BANERJEE, Calcutta.

During anthropological tours among the various tribal populations of India, head hair samples were collected, mainly for, histological studies, and the hair forms were, noted previously. The data for the present study comprise, 167 Oraons, 152 Mundas, 26 Pahiras, 41 Kurmi-Mahatos, 25 Adiyans, and 88 Paniyan individuals. Hair forms of the above tribes, were studied according to the classification of Mollison. It appears from the present study that the leiotrichy occurs in conspicuously higher proportion than the cymotrichy among the South Indian tribes, where the cymotrichy appears to be greater than leiotrichy.

(d) Human Biology.

8. Blood Groups of the Rabhas.

BHUBAN M. DAS, Gauhati.

During the winter months of 1955, blood group investigations were carried out by the writer among the Rabhas of South Goalpara in Assam. Blood samples from 300 males and 300 females of the Rabhas were grouped.

The present paper deals with the percentages of the A, B, O, blood types and the frequencies of p, q, and r genes. The data on the two sexes have been dealt separately and then the two data have been compared.

9. Genetical Study of certain Endogamous Gujarati Groups.

GIRISH N. VYAS, Bombay.

Classification of man on the basis of biological differences is of recent advent. There are two chief methods in study of biological differences—(1) Morphological method and (2) Genetical method. The genetical method offers several advantages over the morphological method. In India, Sanghvi and Khanolkar made a beginning of Genetic study by selecting the Endogamous groups as the ultimate units of investigation. Following this example, the present study of ABO, A_1A_2, MN,Rh (—C, —c, —D, —E) and Duffy blood groups, secretors and nonsecretors of group substances in saliva, P.T.C. taste reactions and colour-blindness was undertaken for the following endogamous groups :—(1) Kapol Vaniai (2) Bhangi Harijans of Saurashtra (3) Cucchi Lohana (4) Audichya Brahmins or Shihor Sampradaya (5) Leva Patidars of Charotar (6) Talavia Dubla.

The results have revealed an interesting pattern of genetical relationship between various endogamous groups. The total data was statistically evaluated and χ^2 values for each genetical character with respect to 15 combinations of the 6 endogamous groups were determined. Finally, the genetical difference, χ^2, was determined by the method adopted by Sanghvi. The results, surprisingly, suggest close genetical similarity between Cucchi Lohana and Talavia Dubla.

10. Study of Certain Hereditary Characters in Parsis.

H. R. MASTER, Bombay.

I. A genetical study of hundred families belonging to the Parsi Community in Bombay was undertaken for the following characters :—1. A_1A_2BO blood groups 2. MN blood groups, 3. Rh blood Groups with subtypes, 4. secretion of the ABH group substances in the saliva, 5. Taste reaction to phenylthiocarbamide (P.T.C.), 6. tongue movements, *viz.*, (a) rolling (curling), (b) twisting, (c) folding and (d) clover-leaf formation, (7) hair, *viz.*, (a) mid-digital (M.D.H.) and (b) metatarsal (M.T.H.) and (8) colour vision. The data were further made use of to elucidate the mode of inheritance in characters 5, 6, and 7, and the analysis has thrown light on the problem of heredity. The data were also made use of to study the incidence of the characters among the Parsis.

II. Three hundred sib-pairs were studied separately for the detection of autosomal linkage in the above mentioned first seven characters. The sib-pairs were statistically analysed by the generalized method of Mohr.

11. Further Studies on the Frequency of Multiple Births in India.

S. S. SARKAR, Calcutta.

In an earlier study (1943-44), based on 313 pregnancies from 41 hospitals from various parts of India, for the period 1936-42 in the majority of the cases, it was found that twin births occur in 1·27% (1 : 79), triplets in 0·01%, and quadruplets in 0·0003%.

The present study covers 49 hospitals, with the majority of the statistics for the period 1942-47. The year 1942 was again included in the present study as a measure of check. The present study reveals for the period 1943-47 a total number of 3,835 twins, 38 triplets and 1 quadruplet in 355,514 pregnancies, which gives a percentage of 1·08 (1 : 92·7), 0·001 and 0·0003 respectively. There appears to be a fall in the frequency of twin births during the two periods, which has been discussed.

(e) Constitution.

12. Constitution in Relation to Physical and Mental Health.

S. M. BHATNAGAR, Bombay.

This study is a preliminary report on an attempt to correlate the physical build of an individual with the common ailments from which he may suffer. The medical men students (ranging between 18 to 20 years) of the first year class are the subjects of observation in this study. A set of criteria has been prepared for the purpose of comparative study and for determination of the constitution. The criteria are :—

1. Height. 2. Weight. 3. Armstretch. 4. Lengths of trunk, upper limb, and lower limb. 5. Chest in inspiration and expiration. 6. Abdomen—girth at the level of umbilicus. 7. Costal angle at the costal margin. 8. Ribs—obliquity, taken by measuring the angle between the vertebral column and the tenth rib, on an X-ray picture of the chest in mid-respiration of an individual in an erect posture. 9. Aortic pulsation (i) visible (ii) palpable or (iii) non-palpable in epigastrium, in a recumbent position. 10. Interspinous and transtubercular distances. 11. Distance between the tip of acromion of one side to that of the other side.

A short questionnaire pertaining to organic system disorders and some basic emotional reactions, is issued to the subjects under observation.

It is hoped, that in addition to immediate and interesting information obtained, this study would, on the basis of a long term follow-up of the medical students, provide a basis for understanding an individual in relation to a similar environment of the group.

(f) Ethnology.

13. Preliminary study of the Racial Affinities of the Oraons of Ranchi.

PAPIA BHATTACHARJEE, Calcutta.

In 1956, 100 males and 110 females were measured among the Oraons of Mandar, Ranchi District. The data have been analysed to find out the extent of sexual variation. It is observed that in the majority of the characters, males have greater mean values than the females, excepting in the case of length-breadth, length-height, jugo-frontal, and nasal elevation index, in which female values exceed that of males. Previous anthropometric data on male Oraons (Risley in 1891, from Chotanagpur, Basu in 1933, from Lohardaga, Ranchi District and Majumdar in 1949 from Mirzapur, U.P.) have also been utilized for comparison. The findings of the present writer approach very closely to that of Basu ; and occupy a medium place in respect of mean values between that of Risley and of Majumdar. Risley's data and Majumdar's data also differ from one another widely.

14. The Naga.

T. C. RAYCHAUDHARI, Calcutta.

An ethnological study of the Nagas of North eastern India based on the somatic study of the Kabuis, Aos, Angamis, Lhtas, Asringias and Rengmas.

II. SOCIAL ANTHROPOLOGY.

(b) Primitive tribes.

15. Ganjus of Midnapur.

P. K. BHOWMICK, Calcutta.

Ganjus of Midnapur are a fast decaying tribe. They are only 23 families consisting of 137 people. To an Anthropologist, therefore, they provide a subject for special study to determine the various causes that led them to their present state and suggest the possible measures for their survival.

An attempt has been made to probe into their social and economic conditions in the appended note. The Ganjus, as all other tribes living in the proximity of their habitation, have their own caste, social, religious, and village organizations. These people are mainly agricultural. During the idle season they also work as day labourers. The clan is not migratory in nature.

Ganjus are also a festive people. They have a good many festivals, the principal ones being Karam and Bandana. Dancing, singing and communal feasts are a part of these festivals.

In religion they broadly follow the Hindu pattern. They worship Sitala as well as their tribal deity Baram and manifold spirits.

The marriage custom of these people is also similar to that of the lower caste Hindu people. Bride price has to be paid in every marriage. The tribe is exogamous. Marriage within the same clan is permitted under special circumstances. Polygyny was also in vogue amongst them in the remote past.

Joint families are the order of social structure. Cremation of the dead and observance of 10 days of pollution as a mourning period resembles more or less the Hindu pattern.

They believe in the existence of God, but have no conception of manifestations.

They are now faced with the problem of bare survival. The only hopeful sign today of their overcoming a disaster is that they have developed a special zest for education and have actually made a little progress towards that end. It is hoped, therefore, that given proper facilities in educational and economic spheres there will be a time not far from now when they would not only be able to survive but would also catch up in status and advancement with other civilized groups of people living around them.

16. The Changing Phase of a Travancore Tribe—The Ulladan.

K. GNANAMBAL, Calcutta.

The Ulladan living in the Reserve Forest Areas of Central Travancore form a tribe as distinguished from the Ulladan living in the vicinity of Kottayam. Mateer in 1883 described them as a nomadic jungle tribe of wild and timid savages. Thurston in 1909 said that they had thatched huts, woven mats and used earthen pots. Census report of 1931 reveals that the tribe had evolved organized village life and permanent cultivation. Iyer in 1939 has described the group as possessing distinctive tribal characteristics like clan organization, sororate, levirate, belief in tribal gods and spirits, taboos and rituals.

By 1954, it was noticed that many of the items of their tribal culture had changed. Well-built huts, brass, aluminium and enamel utensils, pieces of modern furniture, civilized clothing, permanent cultivation and the supplementary earnings by daily labour and sale of honey, bananas, etc., absence of rituals and taboos mark them out as a group emerging from out of the Tribal horizon. Environment, Linguistic ties, improved means of communication, proximity of settlements to highways have contributed to their cultural osmosis. The group has developed a keen sense of political status. It needs proper guidance to take it safely through the rapid process of transition and make it a well adjusted unit in its own cultural setting.

(c) Demography.

17. Demographic study of a Santal Village.

PARAMANANDA PRAMANIK, Calcutta.

In this paper, a general picture of the village Daulti, P. S. Binpur, Dist. Midnapore is revealed. Only basic and more static features have been analysed on the demographic data so far collected. Equal stress has been given both on Santals and non-Santals for analytical purpose.

It is interesting to note that although the Santals were the first settlers of the village yet were outnumbered by the non-Santal immigration.

Simple family is dominant in all the groups although the percentage of joint-family cannot be ignored. In the village, number of females exceeds that of males. Early marriage is preferred by both Santals and non-Santals and remarriage after being widowed or divorced is a very common occurrence.

(d) Social influence on personality.

18. Effect of Social Cataclasm on Personality.

U. GUHA, Calcutta.

During the riots in East Bengal, the Hindus were forced to leave their homes and hearths, and had to undergo tremendous physical and mental sufferings. This gave an opportunity to study the effect of social cataclasm on personality. This study constituted a part of the tension-study under the auspices of UNESCO among the East Bengal refugees in Jirat (Hooghly District) and Azadgarh (24-Paraganas) colonies. The material of this paper has been collected from the life-sketches of fifty adult women of these two colonies. Analysis of these life-sketches show that :

1. The affected personality tries to protect itself psychologically against social disruptions by various defence mechanisms. The ego "Wills" the situation to be normal. Intense sufferings had to be undergone before the refugees could break their psychological moorings from Pakistan. This shows the persistence of the goal-directed behaviour of the personality. The pull of the familiar is also very strong. The unknown is shied at because of its unstructured nature.

2. Certain personality responses develop under extreme frustration. Our subjects reacted to it by resignation, conformity, fantasy, displaced aggression, ingenuous planning, etc.

3. Attitudes oscillate more rapidly than temperament or basic personality traits.

4. When social cataclasm verges into personal catastrophe the id comes to the front.

5. Even social cataclasm can rarely bring radical changes in personality.

III. ARCHAEOLOGY.

Palaeolithic Implements.

19. Lower Palaeolithic Industry of Amirdhamangalam, Chingleput, Madras.

P. C. DUTTA and PABITRA GUPTA, Calcutta.

A detailed study has been attempted in this paper of the Palaeolithic implements collected from the villages Amirdhamangalam and Guruvaijukundigai in the year 1954. The site is located on the lateritic land surface of Ponneri Taluq in the district of Chingleput, Madras. The collection consists of palaeolithic implements comprised of an absolute majority of core and a small number of pebble and flake tools. From the study of the tools, it is revealed that the typical tool is the peariform biface on core. Although the normal core techniques *i.e.*, the Abbevellian and Early Acheulian have been employed, the frequency of Abbevellian technique is conspicuous.

Techno-typologically, the Amirdhamangalam biface and the Madras biface show striking similarity. This biface technique also recalls the technique employed to prepare the Mayurbhanj biface.

20. A Lower Palaeolithic Station near Bhangarh Dist. Alwar (Rajasthan).

K. V. SOUNDARARAJAN, Delhi.

The paper deals with the discovery, by the author, of a Stone Age station in the Sanwan nadi basin in Alwar District. The importance of the area consists not only in the 'in situ' cemented gravels on the banks of the river here which had preserved a tool industry, but also owing to the tools themselves revealing a pertinent typological relationship between the Southern bifacial hand axe facies and the Northern 'Sohan' pebble tool facies. A study of the tool development both from the 'in situ' specimens and from the many scattered in the heavy shingle bed of the river, (totalling to upwards of eighty tools) would suggest the 'pebble-flake' tradition meeting the north-ward diffusing bifacial hand-axe family in its (latter's) Middle-Upper 'Acheulian' stage, and thus is one step forward in our knowledge of the relationship of these two main tool cultures for this part of the subcontinent. No less significant is its nearest-yet-known location to the Potwar-Shivaliks 'Sohan' cultural zone The absolutely hardened gravel conglomerates of the site would hold also the key to the double variation in the climatic regimes during the Mid-Pleistocene at this site. The observed fact of the hardened and cemented tool bearing gravel bed in the other affluent limbs of the Sanwan river near Tehla, and a probably analogous tool assemblage at another site in the vicinity between Alwar and Thana-Gazi would appear to strengthen the data revealed by the main site near Bhangarh.

IV. CULTURAL ANTHROPOLOGY.

(a) Primitive Religious.

20. The Supernatural World of the Tarik of Car Nicobar.

N. DATTA-MAJUMDER, Calcutta.

Car Nicobar, the northern most of the Nicobar group of Islands in the Bay of Bengal, has an area of 49·02 sq. miles and a population of 8,324. The people of the island call themselves *Tarik* (which means 'man') and speak a language which belongs to the Mon-Khmer branch of the Austro-Asiatic sub-family of the Austric family of languages.

The supernatural world of the Tarik consists of *Teo*, a High God, innumerable spirits, good as well as evil, and the heavenly bodies namely the sun, the moon and the stars. *Teo* is believed to have created the sun, the moon, the stars, the sky, the earth, the sea and everything else. It is He who has put the Tarik in the Island of Car Nicobar, and gives them plantations and children and does them good in other ways.

The spirits of the deceased ancestors and relatives are known as *malaha*. They do good to the people and are worshipped by offerings of yam, taro, pigs, fowls and other eatables available in the island. The category of *malha* may be sub-divided into four groups :

(1) *Malaha* (normal), that is, the spirits of those who have died a natural death.

(2) *Malaha Tawf-Eali*, that is, the spirits of those who have been murdered.

(3) *Malaha-Topojno*, that is, the spirits of those who have been drowned in the sea, and

(4) *Malaha-Kumsidjnora*, that is, the spirits of those who have committed suicide. It is the normal *malaha*, who do good to their living descendants, but the other *malaha* do neither good nor harm to the people.

The evil spirits or *siö* may be sub-divided into three groups :

(1) *Siö-Alenchon*, that is, those spirits who live in the jungle.

(2) *Siö-Elmaye*, that is, those spirits who live in the sea.

(3) *Hunaye*, that is, those spirits who can transform themselves into any shape, for example, that of man, pigs, dogs, birds, etc. They hover about in the sky. The jungle-*siö* and the *hunaye* are responsible for sickness of the people. The *Siö-elmaye* cause rains, storm, thunder and lightning in order to prevent sea-farers from either reaching their destination or returning home, so that they may be drowned and increase the number of the sea-spirits. The evil spirits or the *siö* are not worshipped, but they can be propitiated or driven away by the *Tatarong* or medicine-men. The most effective weapon for driving them away is a pointed wooden spear called *Tachoi*. No iron or other weapons are used or considered effective for the purpose.

As sickness is caused by evil spirits, a *Tatarong* is invariably called whenever there is a case of illness. The method of treatment adopted by the *Tatarong* has both secular and spiritual aspects. He not only depends upon the medicinal effects of various kinds of jungle herbs, but also invokes the help and blessings of the *malaha*, and especially of the powerful *malaha* of the deceased medicine-men.

The sun (*Tabui*) is regarded as a male, and the moon (*Chinget*) a female. The stars (*Miliuja* or *Tamusamat*) are believed to be the children of the sun and the moon. The sun helps the people by giving them light. The moon, by her periodical appearance and disappearance, enables them to know the change of the month and the year. And the stars guide them in their sea voyages to Chowra and back. These heavenly bodies are not worshipped or given any material offerings. But when the sun or the moon is covered by the clouds (especially in the rainy season), the Tarik will sometimes look up and pray to them to reappear by saying "what is wrong with us? Why have you hidden yourself?"

(b) Cross cultural studies.

21. Validity of the Rorschach in Cross-cultural Studies.

P. C. RAY, Calcutta.

Introduction :— This paper deals with the validity of the Rorschach in cross-cultural studies. The test was applied on Abor and Gallong who are related but distinct tribes inhabiting the mountain valleys of the Siang Frontier Division.

Subject :—All the available boys numbering 49 Abors and 15 Gallong and comprising about 50% of the school population were examined.

Problem :— To find the validity of the Rorschach in cross-cultural studies by correlating Rorschach variables with independent measures of corresponding personality processes.

Methodology :— In view of the relevant discussions, the author decided to ascertain validity from the degree of concomitant variations among Rorschach variables represented by Rorschach scales, depicting continuous extroversion-introversion, aggression-nonaggression and anxiety-nonanxiety and the corresponding Attitude scale variation.

Findings :— The reliability of the Attitude scale has been found by the split-half method and the validity from the correlations with teachers' estimate. The scale has been found to be valid and reliable. The next course followed was to correlate the Rorschach and the Attitude scale ratings. All the correlations are found to be significant for the continuums extroversion-introversion and aggression-nonaggression. So the scales show validity regarding these variables. The correlations regarding anxiety-nonanxiety continuum are not significant. However, pronounced anxiety shows tentative validity.

Conclusion :— It may be concluded in view of the findings that personality structure in cross-cultural studies may be ascertained by this test.

V. SOCIOLOGY.

(a) Family.

22. Problems of Family Planning among the Scheduled Tribes of West Bengal.

B. K. ROY BURMAN, Calcutta.

Even a few generations ago most of the Scheduled tribes of West Bengal were semi-migratory population—their main source of livelihood was cultivation of jungle tracts and fallow lands; and after the land was fit for more advanced people to settle, they used to recede to more outlying areas to repeat the process. For them large family meant not only extra mouths to feed but extra hands to work. Now the objective condition has changed but the old psychological stereo-type remains. Birth of large number of children is therefore highly valued in tribal culture. This is enchanced by high infant mortality due to various reasons including diet and working habit of expectant mothers and also magico-religious belief and practices. For success of family planning it is indispensable to reduce infant mortality. Recent tendency of the tribals to marry at earlier age in imitation of the Hindu neighbours has further complicated the situation. These should be tackled through social education rather than direct campaign of family planning.

23. Family Structure of the Lodhas of West Bengal.

P. K. BHOWMICK, Calcutta.

The Lodhas of West Bengal were thought to be a criminal tribe before the revocation of the Criminal Tribes Act. They are mainly found in jungle tracts of West Midnapur. A section of them practise agriculture whereas the other section pursues the collecting and selling of the jungle produce. The Writer has studied 368 Lodha families *i.e.* 29·5% of the total lodha population. In this paper he described clearly how joint-families are in vogue specially in agricultural areas where the people have better economic footing whereas these have been split up in the areas where poverty and insecurity of life are more pronounced. He has also described division of labour, mutual co-operation of the members in a family. There are few instances of shifting of residence, if bridegroom has settled to his wife's father's village. These are according to writer (i) earning capacity of the woman, (ii) high bride price, (iii) wrong adjustment of the bride in her husband's place, etc.

24. Residence in Wife's House Among the Riang of Tripura.

BHABANANDA MUKHERJEE, Calcutta.

Chamarikami, a custom among the Riang makes it obligatory for a man to stay and work in the house of his wife for three years immediately after his marriage. This custom is not in any way similar to the usage,—'Marriage by service'. No economic motive whatever is embodied in it. It aims at (1) initiation in the ritual procedure, and (2) social adjustment with affinal kin. Owing to changed condition this custom instead of bringing about behavioural adjustment, is found to be a potent cause for greater frequency (62·06%) of divorce.

25. Kinship and Marriage of the Riang of Tripura.

BHABANANDA MUKHERJEE, Calcutta.

Riang kinship system owes its development to the concepts *sandai* and *Hokchu*. The classification of kin according to these concepts seems to be on the principle of bilateral recking. The kinship system resembles that of the Kurds, the Balinese and the Kwakiutl of North Pacific Coast of America in the identity of certain kinship terms. Both exogamy and endogamy with parallel (17%) and cross-cousin (10·1%) marriage are prevalent. The author suspects that endogamy and parallel cousin marriage were the earlier rules.

(b) Village.

26. Effects of Urbanization on a Delhi Suburban Village.

INDERA P. SINGH and H. L. HARIT, Delhi.

The village Khampur situated nearly 8 miles in the direction of South-West of Delhi was studied to judge the effects of urbanization on the various occupational patterns in that village. The cultivable land possessed by the landlords of the village was reduced from 611 acres (1908) to 55 acres in 1956. This reduction in land-holding was caused by the development of new housing colonies for refugees and Indian Agriculture Research Institute.

Only 5 out of 105 families have left the village for other places in search of livelihood. Most of the big landlords (Rajputs) who were paid substantial compensation for their land have built houses for rent purposes and established contract business of quarries and stone-crushers. The poorer ones are working as labourers in the nearby factories. The Brahmins also have left their traditional occupation of priest-craft. They have opened shops selling milk and merchandise, while one of them works as a mechanic. The Chamars who were working as tenants or farm-labourers have obtained jobs in the factories and quarries. The Kumhars—potmakers have also given up this work and are now engaged in carrying earth on the donkeys for selling in the town. The Nais—the barbers also do not work in the village now-a-days but have set up shops of hair cutting in the city. The Dhobies although are still engaged in washing clothes get their charges paid in cash and not in kind. The Bhangis also get cash money paid for their services.

The Jajmani system which united the various members of the village in one unit has been completely disintegrated. No payments are made at each crop for services rendered by different people. The only relationship maintained between the landlords and their 'kameen' wants to get a loan. But these loans are not given now without mortgaging gold or silver ornaments or the house.

The change in occupations has resulted in general prosperity of people, but there is a lurking fear of insecurity in their minds. The social relationship between different castes have not been much affected.

27. Carak Festival in a village in West Bengal.

G. CHATTOPADHYAYA, Calcutta.

The writer has, to begin with, described the Caṛak festival as celebrated in Bengal from his own observations as well as from the studies of others. Then, he has pointed out its many similarities with the Dharma worship as celebrated in Bengal, and shown how and why these elements have come into Caṛak. At the end, some social implications of this festival have been briefly discussed.

(c) Caste.

28. Changing Structure of Caste in a Village of Northern India : a Case Study.

DHARANIDHAR PRASAD SINHA, Ranchi.

Functional Specialization of caste has been an important factor in keeping intact the frame of caste system in an Indian village. This is registering change. The people from the lower castes have shown a desire for moving up in the social scale. However, there is no demand for the abolition of caste system, as such.

The Pasis of Uttar Pradesh in 1949 decided to put on Janeu (sacred thread) and thus to raise their status. In one village, near Lucknow, where this study was made, the Pasis had an elaborate ceremony for putting on janeu. Though the ceremony passed off uninterfered, the villagers took strong objection to it. The village Panchayat decided to ostracize them. All privileges of the Pasis were withdrawn, the subleted land, the use of well and open field, the services of the other castes etc. It became difficult for the Pasis to live in the village. A section of the Pasis who were economically handicapped surrendered the janeu. But the others approached the Baruni and the Jwar—greater caste Panchayats which had taken this move. The greater caste Panchayat lodged the complaint in the Police station against the Thakurs—Khatriyas of the village, who were instrumental in this boycott, and to reorganize the ceremony in the village. It was held and the Pasis put on janeu again. The ostracism was reinforced by the Panchayat. The Police inspector came and dismissed the case. The Pasis finding themselves helpless again, surrendered finally the janeu to the Panchayat. It is important to note that though the people of the castes below the rank of Pasis had no objection against the use of janeu by the Pasis, they cooperated with the Panchayat.

The case points to the few things: there is a conflict between higher and lower castes; in religious and social prerogatives every caste has objection against those castes which are lower than it, not against those which are higher, in social frame; there is a growing 'solidarity' among the people of a caste, cutting across several villages and the unity between the castes. of the village is decaying.

(d) Historicity.

29. History as a Medium in Anthropological Investigation.

SURENDRA KUMAR NAVLAKHA, Calcutta.

This paper questions the historicity of so called historical theories of cultural anthropology and analyses their manifold and serious shortcomings in this respect. Presenting the central principles of Historical Standpoint, it endeavours at making out various possibilities that lie in true historical reconstructions as important source of anthropological knowledge. Examples from two societies from India—Bhumij and Bhil—are given to demonstrate the proposed theoretical constructs.

VI. MUSEOLOGY.

30. An Approach to the Preservation Technique in Museum.

MINENDRA NATH BASU, Calcutta.

Everything in this world decays in course of time, but science tries to keep it in good trim for a certain length of time. The destructive agencies of a museum specimens are mainly of two types,--climate and insects. The injurious conditions for preservation and various enemies of the museum specimens with their remedial measures are discussed. In the field of preservation of museum specimens the conception and the approach derive from the fact that the problem is essentially lengthening of the span of life of the specimen. That is why honesty and sincerity with full patience and observation of time factor should be taken into full consideration.

SECTION OF MEDICAL AND VETERINARY SCIENCES

President:—Dr. A. K. Bose, M.Sc., M.B., M.R.C.S., M.R.C.P.

Abstracts

1. Studies in Comparative Detoxication Mechanisms.

D. ROY CHOWDHURY and D. P. SADHU, Calcutta.

Studies on the fate of foreign organic compounds in the animal body has shown that after intramuscular administration of benzene and bromobenzene at the level of 1g/kg body weight in rats, rabbits and guinea-pigs, there is a marked rise in the ethereal sulphate output in the urine. The conjugated phenol fraction is also increased to a great extent. The ethereal sulphate increases at the cost of the inorganic sulphate fraction. The normal value of ethereal sulphate excretion per day/animal is 0·7 mg. to 0·9 mg in rats, 3·4 to 4·5 mg. in rabbits and 3·2 to 4·6 in guinea-pigs. After a single dose of 1g/kg of benzene the values changed as follows :—

Rats 192-2·5 mg, rabbits 5·2 and guinea-pigs 6·8 mg/day.

The ethereal sulphate output was more than normal when cystine was added to the diet of rats. It was estimated that about 20% of a single (1 g/kg) dose of benzene was excreted as phenol and its conjugates.

2. Effect of Thiamine Hydrochloride and Glucose administration on the galactosuria in skim milk fed rats.

SUDHINDRA CH. ROY and D. P. SADHU, Calcutta.

Rats fed on skim milk excrete galactose in urine from the 2nd day of treatment. But the amount of galactose in the urine gradually diminishes from about the 9th day and the galactosuria almost disappears by about 16th day. Injection of thiamine hydrochloride, however, maintains galactosuria to the original level, while glucose injection causes a quicker decrease of galactosuria. This relationship of thiamine and glucose is being studied on the blood sugar level.

3. Studies on sodium potassium depletion and its possible relationship with the functions of adrenal cortex.

S. B. CHOWDHURY, D. P. SADHU and A. K. PUTATUNDA, Calcutta.

A condition of stress was produced in albino rats by the depletion of sodium or/and potassium by ion-exchange resins and its effect on the adrenocortical functions was studied by examination of 17-ketosteroid excretion in urine of these rats. The increase in the case of sodium depletion is 18% of the normal value while in cases of potassium depletion or the combined depletion of sodium and potassium, the increase in 17-ketosteroid excretion was 30% and 29% respectively.

The alkaline phosphatase activity of the cells of the proximal convoluted tubule of the kidney was markedly increased, but the enzyme activity in the ovary and adrenal cortex, although increased, was not so much pronounced as that in the kidney. Acid phosphatase activity in these organs was also increased to some extent.

4. Chromatographic separation of glucose and galactose from brain cerebrosides.

BHUPEN CHAUDHURI and D. P. SADHU, Calcutta.

Rats weighing 100-150 gm. were used for this experiment. They were sacrificed and their brain extracted with alcohol and ether mixture. An aliquo of the final extract was evaporated and then hydrolysed with 6 N Hcl. This was then neutralized and spotted on strips of Whatman No. 1 filter paper. The strips were phenol-water which was allowed to drip from the serrated lower edge of the desending chromatograph. Strips were air dried and colour developed with a mixture of water saturated n-butanol, phthalic acid anilin. Glucose and galactose were separated and the coloured spots taken out and extracted with glacial acetic acid. The colour of the eluate was measured spectrophotometrically by a Unicam spectrophotometer at 480 mμ.

5. Catechol Amine excretion in Tropical Eosinophilia.

H. S. CHAKRAVARTI and Mrs. BINA MUKHERJEE, Calcutta.

Biology of Tropical Eosinophilia is obscure. High eosinophil count and occasional improvement with ACTH and corticosteroids rather suggest a possibility of dysfunction of adrenal gland. Both cortical and medullary hormones, the latter through pituitary-adrenal axis is well known for eosinopenic effect. In order to ascertain the cause of high eosinophil count in cases of Tropical Eosinophilia, 24 hours excretion of catechol amines in urine were investigated in 24 cases of Tropical Eosinophilia before and after treatment with organic arsenical preparations. The results were compared with that of 26 normal individuals amongst laboratory workers. Biological assay on spinal cat's blood pressure was done after extracting catechol amines with alumina and eluting with H_2SO_4.

Normal value obtained was in the range of 10·7 to 90·3 microgrammes equivalent of adrenaline, the average being 34·8±21·1.

In Tropical Eosinophilia before treatment, value was within the range of 8·4 to 70·9 microgrammes with a mean of 33·5± 16·8 and after treatment the value was 40·6±22·7 microgrammes.

Values in the different groups when subjected to 't' test did not show any significant variation indicating that in Tropical Eosinophilia there is no abnormality in the excretion of catechol amines in the urine. Significance of this finding has been discussed.

6. On the Standardization of Therapeutic Mixture of Adrenalin and Pituitary Extract.

S. K. GANGULY, SRIPATI BOSE and S. K. DUTTA, Calcutta.

Hormones are often used in therapy singly as well as in combination. Adrenalin and pituitary in combination is one of such types of hormone mixtures used in emergency. Standardization of such a therapeutic mixture consisting of adrenalin (0·05%) and pituitary extract (5 oxytocic units per ml.) is confronted with difficulties owing to the interference of one with the other in the biological methods of assay of the individual component in the mixture.

Standardization of adrenalin in the mixture of adrenalin and pituitary extract by ferro-citrate method according to Roy Dotty (1948) was found to be applicable where pituitary extract did not interfere appreciably.

Usual methods of standardization of adrenalin and pituitary extract could however, be applied after separation of adrenalin and pituitary extract by adsorption chromatography. On passing the mixed solution (5 ml) through a column (5×0·5 cm) of cation exchange resin, Zeokarb 215, adrenalin was adsorbed in the column and pituitary extract passed out unadsorbed. Pituitary extract could be biologically assayed from the filtrate and adrenalin after elution with normal hydrochloric acid or twice normal sodium chloride.

7. Progressive histological changes in the pancreases of guinea-pigs subjected to daily injections of some diabetogenic agents.

H. D. BRAHMACHARI, GITIKA DUTTA GUPTA and MAHENDRA KUMAR, Pilani.

Alloxan is known to produce a specific diabetogenic effect by degenerating the B-cells of the islets of langherhans of the pancreas. A number of other substances are also known to be diabetogenic, but the mode of their action is not fully understood. Some intermediary metabolites viz., aceto-acetates and b-hydroxy butyrates were found to produce a state of hyperglycemia, glycosuria, acetonuria and lowered tolerance for glucose when injected in gradually increasing doses to guinea-pigs. Aceto-acetates and B-hydroxybutryates were found to inhibit the hypoglycemic effect of insulin "in vitro" and "in vivo", and the potency of the pancreatic insulin (as measured by its hypoglycemic effect) was found to initially increase and then gradually decrease in guinea-pigs getting these injections.

Detailed investigations are in progress regarding the histological changes produced by these substances in the islets of Langerhans of the pancreases of the experimental guinea-pigs. Preliminary studies indicate that the pattern of histological changes brought about by Alloxan and B-hydroxybutyric acid, in the islets of Langerhans is the same. There is initially a hypertrophy of the B-cells together with an increased amount of granules which is followed by degeneration of the islets in later stages, as evidenced by breaking down of B-cells and degranulation. The acinar cells have also been found to be shrunken at later stages. This finding has also been corroborated by the simultaneous observation that the amylase activity/cg. of pancreas tissue increases in early stage of these injections and is decreased in later stages.

8. Vitamin A deficiency and cancer in rats.

BRAHM DUTT, Izatnagar.

Perusal of literature shows no reference about Vitamin A deficiency as initiator of carcinogenesis. An interesting observation was recorded in weaned albino rats on sub-adequate vitamin A diet for a year. The stock colony of albino rats maintained in this laboratory has no history to suggest that the rats belonged to a cancer strain.

Autopsy performed on four vitamin A deficient rats which died after a year revealed multiple round soft growths which looked like a bunch of grapes along the whole length of the intestines and mesentry. In one rat similar growths were seen in the liver as well. To test the malignancy of the growth, glycerine emulsion of the growth was injected in the anterior chamber of the eye of a rabit. An opaque white growth appeared beneath the cornea which continued to extend.

Histopathological examination of the growth obtained from rats revealed features of small spindle cell sarcoma.

9. Melanotic Tumours in Buffaloes.

B. L. PUROHIT, Bombay.

Melanotic tumours, both of the benign and malignant varieties, are encountered in various domesticated animals. Their incidence, however, is comparatively infrequent in the bovines in general and buffaloes in particular. The author was able to collect only three published incidences of melanomata in buffaloes from the literature.

A case of malignant melanoma in a grey Surti buffalo is described. The primary tumour was present on the hock joint and metastatic growths were present in lung, liver, spleen, kidney, brain and serous membranes. Histology of the primary and the secondary growths is described.

Nature and origin of melanin is briefly discussed. Various theories regarding the histogenesis of melanomata are briefly reviewed. The author is inclined to concur with the theory of epidermal origin of these tumours in the light of his studies.

10. "Observations on the Incidence of Dermal Manifestations in Intestinal Parasities and Bacterial Diseases."

K. C. SAHU, Cuttack.

For the last six years investigations were carried out on 1074 patients suffering from different dermal manifestations, Leucoderma, Allergic dermatitis, Depigmentation of the skin, Urticaria, Hyperpigmentation of skin etc. coming from different parts of the state of Orissa in Out-patient and In-patient departments of the Skin diseases of S. C. B. Medical College Hospital, Cuttack.

Incidence of dermal manifestations of intestinal parasitic and bacterial diseases was observed in 320 cases. Out of them depigmentation of skin occurred in 46%, leucoderma 24%, allergic dermatitis 11%, urticaria 7·5%, hyperpigmentation 7%, koilynychia 2%, painful excoriation of anus 1·3%, anal ulceration 0·3%, vaginal ulceration 0·3%, leucorrhoea 0 3% and ulceration of penis 0·3%.

Percentage of incidence of dermal manifestations were observed in the following intestinal parasitic and bacterial diseases.

	Depigmentation (147 cases)	Leucoderma (77 cases)	Urticaria (110 cases)	Allerg.der. (77 cases)	Hyperpigmentation
Amoebiasis	35·5	64	36	38·4	42·8
Ascariasis	20·5	10·8	50	31·6	24
Giardiasis	15	4·8	—	11·6	9·2
Ankylostomiasis ...	15·5	—	—	25·6	24
Bacillary dysentery ...	13·5	20·4	—	—	—
Enterobiosis ...	—	—	—	2·8	—

Incidence was highest in the age group 20-30, being more in males. Maximum number of cases and its incidence was observed during hot and moist months and lowest figures were during winter months. The highest figure 15% was recorded in June and the lowest figure 4% in December, though the incidence is prevalent throughout the year.

11. "Leprosy is also a Cause of Facial Paralysis."

K. C. SAHU, Cuttack.

The present discussion refers to my series of ten cases of facial paralysis due to leprosy, who came under my observation and treatment. The aetiology of facial paralysis is varied. Leprosy has been hardly described as the cause of facial paralysis in the literature or seen in a text book of medicine but in the tropical country it should be kept in mind while investing such a case. In my series there is no neuralgic pain nor sensory disturbance in the area supplied by the facial nerve. Areas of skin supplied by the affected nerve never becomes anaesthetic to pain and temperature. The affected skin area appeared macular in two cases but in the rest slightly pigmented areas are found. The cases have often been missed as cellulitis or erysipelas or due to some underlying condition like sinusitis etc.

Lesions of the seventh cranial nerve gives rise to paralysis, more common in the upper part of face. Paresis and later paralysis of the orbicularis oculi muscle cause ectropion and lagophthalmos of the eye. Lower part of the face are affected sometimes and involvement of the orbicularis oris produce ectropion of the mouth which results in dribbling.

12. Histoplasmosis in India.

P. C. SEN GUPTA, Calcutta.

The first proved case of histoplasmosis in an Indian was reported by Sen (1953) and by Panja and Sen (1954). A case of generalised histoplasmosis in a Bengalee clerk was admitted in 1957 into the hospital of the School of Tropical Medicine, Calcutta. This case was investigated thoroughly and the fungus *H. capsulatum* demonstrated by the workers of the medical mycology department of the School in culture. Smears of sternal marrow and spleen puncture material and histological section of an ulcer in the mouth of the patient, showed the fungus. The patient was treated with hydroxystilbamidine but this proved of no avail and the case terminated fatally. More recently *H. capsulatum* could be isolated from a case with ulcer in the mouth, admitted into another hospital.

These cases show that this dangerous form of deep mycosis is not unknown in India and cases with suggestive symptoms should be carefully investigated.

13. Some observations on post-kala-azar dermal leishmaniasis.

P. C. SEN GUPTA, Calcutta.

There has been a marked increase in the number of cases of post-kala-azar dermal leishmaniasis (DL) following the outbreak of kala-azar in Eastern India during the nineteen forties. Analysis of records of 1000 cases attending the Kala-azar out-patients' department of the School of Tropical Medicine, Calcutta, has revealed some interesting facts.

It was noted that relatively larger proportion of kala-azar (KA) cases developed DL towards the end of an epidemic and subsequently than during the epidemic years. This indicates that there is a rise of immunity against the visceral disease (but not against the dermal condition) at the end of an epidemic of kala-azar.

Specific treatment for kala-azar, however, intensively administered and using any of the most effective drugs, does not prevent the development of DL (though the visceral disease is cured).

Histochemical study of the lesions of DL showed that the Feulgen reaction was the method *par excellence* for the demonstration of leishmenia in tissue sections. In lesions with scanty infection viz., the hypopigmented macule and erythema.

This method may thus be regarded as suitable for parasitological diagnosis.

Treatment of this disfiguring condition is still not very satisfactory.

14. The effect of splenectomy in drug-resistant kala-azar.

P. C. SEN GUPTA and ANJALI CHATTERJI, Calcutta.

Antimony-resistance has been found to be an important problem during and after the outbreak of kala-azar in Eastern India during the nineteen-forties. The majority of such cases can be cured after prolonged treatment with aromatic diamidine compounds particularly stilbamidine and hydroxystilbamidine. But a small proportion of cases prove entirely refractory to chemotherapy. Splenectomy and chemotherapy has been suggested for such cases.

Four cases that proved entirely drug-resistant have so far been subjected to splenectomy. Also one other case that had splenectomy in England followed by insufficient chemotherapy came under observation for relapse of kala-azar. One of the four cases having splenectomy here had gross hepatic damage and he died 10 days after the operation. Others including the case that relapsed after splenectomy, had intensive chemotherapy subsequent to the operation and all of them were cured. The cure has been permanent in three cases and the fourth case only recently been discharged as cured.

Detailed clinical, haematological and pathological investigations were carried out in all the cases. It was noted that previous to the operation, it was impossible to cause any significant improvement of the blood picture with transfusions and haematinics and the spleen was entirely unaffected by all specific treatment. Splenectomy was followed by immediate improvement of blood count and the cases responded to drugs that had failed previously to effect a cure, though a relatively larger total dose was required.

It was concluded that splenectomy removed a large and possibly the main focus of infection and the hypersplenic mechanism which had been preventing improvement of the blood picture. This led to improvement of anaemia and leucopenia and thus of the general body resistance of the patients who then responded to treatment. The parasite in these cases was possibly less sensitive to antimony or aromatic diamidines than in average cases of kala-azar.

15. On Schistosome Dermatitis : I. Dermatitis in India caused by cercariae of Schistosoma spindale.

M. ANANTARAMAN, Madras.

"Schistosome Dermatitis" of Cort (1928) is now known from all over the world. Bhalerao (1938, 1947 & 1948) referred to its occurrence in India, and reported on an instance in Mysore. *Cercaria srivastavai*, n.sp., possibly belonging to *Trichobilharzia*, was involved in a dermatitis encountered by Dutt (1957).

In Madras, a person collecting snails from a tank experienced itching on his legs, leading to papular dermatitis on the third day and a pustular condition in a week. *Indoplanorbis exustus* from the tank released schistosome cercariae, and the author voluntarily exposed his left hand to them and developed the characteristic dermatitis. Photographs will illustrate these two cases.

The cercariae were identified by feeding them to two goats, which passed eggs of *Schistosoma spindale* on the 46th and 63rd days and also yielded hundreds of

adult worms at necropsy. Buckley (1938) had earlier found these responsible for the 'Sawah itch' in Malaya. Since the fluke is common in Indian ruminants, dermatitis among the rural folk could be attributed to their bathing, washing and fishing habits.

Schistosome dermatitis is to be regarded as an important zoonotic disease in India deserving greater attention from medical and public health men.

16. On the occurrence of Opisthorchis viverrini in domestic cat in India.

M. CHAKRAVARTY & P. K. SINHA, Calcutta.

Opisthorchis viverrini is a common fluke of man and cat in Siam and Formosa. In India there is no record of the occurrence of this species. *O. felineus* and *O. noverca* are common in Indian dogs and cats and it is difficult to distinguish *O. viverrini* from these. Probably that is the reason why this specimen has not been recorded so far from India.

Twelve specimens of *O. viverrini* were collected from the bile-ducts and the intestine of a domestic cat. The diagnosis was based on the following features.

O. viverrini appears very similar to *O. felineus*, but there are distinct points for differentiation. *O. viverrini* is comparatively shorter and wider than *O. felineus*. The oesophagus of the former is comparatively longer than the latter. In *O. viverrini* the two testes and ovary are very near to one another whereas they are well separated in *O. felineus*. Testes are more developed and deeply lobed in case of *O. viverrini*. Vitelleria of *O. viverrini* are arranged in groups of follicles and not like a continuous row of transversely compressed follicles as that of *O. felineus*. The uterine coils of *O. viverrini* are more compactly arranged than those of *O. felineus*. The eggs of *O. viverrini* are shorter and wider compared to those of *O. felineus*.

17. On a new stephanofilariasis in Buffalo in Andaman Islands.

P. K. SINHA & M. S. DAS, Calcutta.

A peculiar dermatitis in the navel flap of buffaloes in Andaman Island was reported by the Livestock Officer there. The etiology of the disease was unknown. In this paper the disease has been described and a new species of *Stephanofilaria* has been incriminated as the causative organism.

The disease has been recorded only in buffaloes which are adult. The imported animals are more susceptible. About 15—20% of the buffaloes in the Island are infected. The disease is most active during the rainy season and abates during the dry and winter seasons. The dermatitis first sets in with redness and thickening of the skin at the naval flap which subsequently breaks and becomes ulcerated. There is itching and sero-sanguinous exudation. The condition aggravates due to rubbing against hard objects. The dry exudates form crusts on the sores. The navel flap in course of time becomes very thick hard and elephantoid. During the winter the disease passes through a quescent stage.

Stephanofilaria andamani n. sp. has been recovered from the scrapings of the affected skin. It closely resembles *S. dedoesi* but differs in some detail. The left spicule of the male is longer and the posterior end is slightly bent. The females are more slender and the vulva is situated at a greater length from the anterior end. Moreover the seat of predilection and the host distinctly differs from those of *S. dedoesi*.

18. Studies on the incidence of helminth parasites in goats in Eastern U.P.

P. K. SINHA, Calcutta.

Goats received for G.T.V. production in the Biological Products section, Bengal Veterinary College, were examined for this purpose. These animals were received from the eastern districts of U.P. and they usually stayed for 2 to 3 weeks in Bengal before they were sacrificed. Therefore the worm burden recorded from these animals mainly represents the worm burden of goats from eastern districts of U.P.

During May 1955 to August 1957, 450 goats have been examined. All the visceral organs from thorax and abdomen were collected and examined for helminthic infection. Out of 450 animals 10 were free from infection, 359 animals were infected with 19,795 *Haemonchus contortus*, 222 animals with 3,390 *Oesophagostomum columbianum*, 31 animals with 714 *Bunostomum trigonocephalum*, 44 animals with 661 *Gaigeria pachyscelis*, 11 animals with 4,560 *Trichostrongylus colubriformis*, 372 animals with 8,384 *Trichuris* sp., 234 animals with 647 *Cysticercus tenuicollis*, 16 animals with 60 *Moniezia* sp., 254 animals with 3,098 *Stilesia globipunctata*, 24 animals with 192 *Avitellina* sp. and 56 animals with 15, 985 *Cotylophoron cotylophorum*.

In addition the following worms were collected from fewer animals : *Fasciola gigantica, Gastrothylax crumenifer, Schistosoma indicum, Moniezia denticulata, Cysticercus gaigeri, Oesophagostomum venulosum, Skrjabinema ovis,* and *Setaria cervi.*

Under the capsule of the liver of two animals several specimens of Linguatulid nymphs were also collected.

19. "The Role of Constipation in Circulatory and Respiratory Disorders."

B. S. KAHALI and M. L. GUPTA, Jaipur.

The bad effects of constipation have been attributed to absorption of toxic amines without much positive evidence. Alvarez et al (1926) have suggested that these effects may be due to distension of rectum. The effects of rectal distension with various pressures, of healthy dogs anaesthetised with suitable fixed dose of chloralose, on circulation and respiration have been studied.

The rectal distension causes slowing of heart with rise of blood pressure possibly due to increased periphereal resistance. Such distension also causes slowing of respiration with increase in depth and prolongation of inspiration. The tidal volume is increased but the pulmonary ventilation per minute is diminished. The circulatory and respiratory effects to distension persist without any decrement as long as the distension is maintained and disappear as soon as the rectum is deflated. This is strongly in favour of a nervous than a humoural mechanism.

From these results it has been concluded that there are stretch receptors in the rectum with reflex effects on circulation and respiration. Like most stretch receptors they do not show adaptation. It is suggested that the distension of rectum and colon, in constipation, sets us a reflex influencing circulation and respiration.

20. Various Vaso-reactive Tests in Subjects with Normal Blood pressure.

B. S. KAHALI, M. L. GUPTA and S. N. GUPTA, Jaipur.

It is known that pressor responses in hypertensive patients are greater than normal. Pressor response to cold pressor test, breath holding test and carotid occlusion test have been investigated in subjects with normal blood pressure.

Pressor response with these various vaso-reactive tests was different. The normal hyper-reactors with cold pressor test gave a normal hypo-reactor response with other tests.

Breath holding test with normal inspiration gave a greater pressor response than breath holding test after maximal inspiration.

It is surprising to find that the cold pressor test and the test, notably that of breath holding, do not show the correlation to be expected from similar or identical physiologic mechanisms.

21. "The Effect of Smoking on the Vaso-reactive Responses in Man".

B. S. KAHALI, M. L. GUPTA & S. N. GUPTA, Jaipur.

Blood pressure response to cold pressor test, smoking and simultaneous smoking and cold pressor test has been investigated in the subjects with normal blood pressure.

Cold pressor test always gave a pressor response. Smoking gave a pressor response in eight cases and depressor response in two cases. Simultaneous smoking and cold pressor test always gave a pressor response which was greater than with either of the stimuli given separately.

It has been suggested that the subjects, which are normal hyper-reactors to cold pressor test, are likely to become hypertensive with smoking.

22. Study of Urinary Nitrogen Excretion Level in Normals and its relation to Dietary Protein intake.

M. L. PAI, Baroda.

Eighteen normal male healthy subjects of age varying between 17 and 22 years living on the side of the country, namely, Gujarat, have been studied for their daily urinary nitrogen excretion. The urinary nitrogen excretion ranged from 3·20 to 8·10 kms. per day, with the average value of 5·90 gms. per day. This is much lower compared to the corresponding standard value given for Europeans, which is 16 gms. per days : The average total protein content of the daily diet taken by the subjects was 59·1 gms. with a range of 43·8 to 76·1 gms. This protein content also seems to be lower than the standard value recommended by League of Nations Health Committee etc. The diet of the majority of the subjects was mostly of vegetarian type, low in animal proteins as compared to the animal proteins rich non-vegetarian type. This factor, namely the vegetarian composition of diet, may perhaps be responsible for the low urinary nitrogen excretion in them. These findings once more bring out the fact that European standards of excretion of urinary nitrogen, cannot be accepted for Indians, for whom, lower standards, obtained after studies done on subjects, belonging to different regions of the country, will have to be made applicable. The significance of the above findings has been discussed in the paper.

23. Ventricular Arrhythmia following Camoquin.

R. B. ARORA and H. R. K. ARORA, Delhi.

While studying the effects of Camoquin on cardiac arrhythmias Arora, Madan and Pathak (1955) and Arora and Madan (1956) observed that Camoquin on intravenous administration was capable of inducing ventricular arrhythmia. This interesting observation attracted attention specially because Camoquin is known to be one of the most frequently used antimalarial in practice. Observation was extended on thirty-eight dogs with Camoquin being given in doses from 5 mg/kgm to 10 mg/kgm with intravenous administration of Epinephrine 60 microgm/kgm in 15 cases. From the results obtained it appears that intravenous administration of Camoquin alone resulted in ventricular arrhythmia in 87% cases, in doses of 10mg/kgm.

In combination with epinephrine 60 microgm/kgm given intravenously it was found to induce ventricular fibrillation in 80% cases. The authors consider it of significance that a drug so often used should cause such serious cardiac disturbances, and that the clinician must be on his guard while administering this drug intravenously.

24. The action of Chloroform, Ether and Ethyl Chloride on the Automaticity of Sino-auricular and Auriculo-ventricular Nodes.

R. B. ARORA, Delhi.

For determining the actions of chloroform, ether and Ethyl chloride on cardiac automaticity experiments were performed on 92 mongrel dogs. Effects were observed on sino-auricular and auriculo-ventricular nodal rhythms under identical conditions that is in the former also chest was opened by a similar procedure and closed accordingly to the modified technique of Arora & Das (1956).

Results obtained in this study indicate that (1) Ether and Ethyl chloride accelerate the impulse generation in S-A node due to depression of nervous cardio-inhibitory influences. Chloroform in small doses causes initial stimulation of evanescent nature followed by a sustained and pronounced depression while in large doses the primary action is depression, (2) The rhythmicity of the A-V node is more susceptible to the depressant action of these drugs. (3) Electrocardiogram shows the disappearance of P wave under the influences of all the compounds studied indicating a profound depression of the auricle. This effect was more frequently elicited by Ether than by Chloroform and Ethyl chloride. This hitherto unexplored property of Ether can be used as a chemical method for the production of auriculo-ventricular nodal rhythm.

25. "Quinidine-like activity of tranquillizing agents."

R. B. ARORA—New Delhi.

Rauwiloid, reserpine, benectyzine and meprobamate were tested for their arrhythmia-combatting properties by the following tests: (1) Isolated rabbit auricles; (2) Aconitine-induced auricular fibrillation; (3) Auricular flutter produced by injury-stimulation procedure; (4) Ventricular ectopic activity following two stage coronary ligation of the dog. In addition, antiveratrinic properties of benectyzine and meprobamate were elucidated. In each case comparison was made with quinidine.
Results obtained in this study indicate that :—

(1) Benectyzine, rauwiloid and reserpine possesses actions comparable to quinidine in auricular arrhythmias as well as in antagonising veratrine response.

(2) Benectyzine and rauwiloid have significant quinidine-like action in ventricular ectopic activity while reserpine is ineffective in abolishing ventricular extrasystoles.

(3) Benectyzine exerts strong antiveratrinic activity and resembles quinidine in not only abolishing the fully developed veratrine response but also in preventing the development of the response in the muscle pretreated with the drug.

(4) Meprobamate is devoid of any demonstrable activity in antagonising veratrine response as well as in combatting auricular arrhythmias.

These findings when put together with the previous findings of Arora, (1955) and Arora & Das, (1955) show that a close parallelism exists between these two otherwise diverse biological properties of the skeletal and cardiac muscles (antiveratrinic and antiarrhythmic).

Since the experimental production of cardiac arrhythmias simulates the clinical disorders, therefore rauwiloid and benectyzine may find therapeutic application in selected cases.

26. Excretion of Hexamethonium in Man and in Animals.

J. K. MOHANTY, Cuttack, Orissa.

The results of work of the author on metabolism of Hexamethonium Bromide (HMB) in body seemed to be at variance with the views of other workers that almost 100 per cent of a given dose of HMB is excreted in urine in 24 hrs. So the question of excretion of HMB in man and in animals had to be re-examined. Samples of urine were collected up to 24 hrs., and in some cases up to 36 hours after a parenteral dose of HMB. Estimation of HMB content of urine was made (i) biologically on mouse pupil, (ii) colorimethically, as well as by the (iii) Reineckate method. For the estimation of HMB only the last method was used by other workers. These parallel tests showed that in man and in animals urinary excretion of HMB in 24 hrs. after a single parenteral dose is about 40 to 60 per cent. Higher figures for the excretion of HMB obtained with the Reineckate method do not reflect the true excretion of HMB since many other substances including apparently HMB degradation products and some unknown substances present in normal urine gave a positive reaction by this method.

No HMB is excreted in bile.

27. A new Series of Spasmolytics.

J. K. MOHANTY and P. TRIPATHY, Cuttack, Orissa.

Twenty seven compounds, which are derivatives of thiazole were screened for possible spasmolytic action using isolated intestinal preparation. Compounds exhibiting fairly good antispasmodic activity were picked up for further study. With each of the selected compounds the exact nature of spasmolytic action, the dose-response relationship, the antispasmodic potency including the MED_{50} were studied. For calculation probit analysis was adopted on the basis that the intestine could be considered to be composed of a population of muscle fibres, the response of which would vary according to frequency distribution of any other biological variate.

The most active compound found in this study, in a concentration of 10^{-9}, blocked the effect of a standard dose of acetylcholine by 50 per cent. The potency of this compound compares favourably with that of some of the known antispasmodics used clinically. Two other compounds of this series also exhibited fairly good antispasmodic action. Further work is in progress.

28. Some Chemical, Pharmacological and Anti-bacterial Properties of Coleus Aromaticus Benth.

ASIMA CHATTERJEE, N. VENKATESWARAN
and
H. N. CHATTERJEE, Calcutta.

The leaves of Coleus Aromaticus have been shown to be very valuable in the treatment of Cholera. Some of the properties of this leaf have been given in this paper.

Chemical

From the leaves of *Coleus Aromaticus* (*Fam. Labiatae*), a steam-volatile phenolic oil has been isolated. It has a pungent smell like thymol and is a strong skin irritant. The yield is 0·3 to 0·4%. The percentage however depends upon the drying of the leaves. This oil is not a single component as evidenced from its paper chromatogram. It is a mixture of several components characterisation of which is in progress.

Besides this phenolic oil, a solid substance (yield 0·3%) has been obtained. It melts at 78°, and is soluble in ethyl alcohol, methyl alcohol, acetone, benzene, petroleum ether (40-60°), and ethyl acetate. The compound is chromatographically homogeneous, crystallises best from ethyl acetate and analyses for $(C_7H_{14})_n$. From elementary analysis the compound has been proved to be a hydrocarbon. Further studies on this compound are underway.

Pharmacological

Although neither of the two chemical fractions exhibited any constant change in the anaesthesized cat, yet the administration of the raw juice caused a sustained rise of blood pressure in the same animal. The raw juice also caused an inhibition of intestinal peristalsis.

Antibacterial

In vitro the raw leaf juice has no bacteriolytic or bacteriostatic properties against the cholera vibrios but after the therapeutic administration of the juice in patients there is an increasing emergence of rough colonies in the plate culture of the stools which appear to replace the smooth-colony producing vibrios pari passu with the clinical improvement.

29. Studies on the liver tissue of P. berghei infected rats.

ANJALI CHATTERJI and P. C. SEN GUPTA, Calcutta.

The oxygen consumption, alkaline phosphatase activity and the glycogen content of the liver tissue of normal albino rats and albino rats infected with *P. berghei* was estimated manometrically and biochemically. Histological studies of the liver tissue and demonstration of glycogen and alkaline phosphatase activity by histochemical methods was also carried out simultaneously. It was found that the oxygen consumed by the liver tissue of rats infected with *P. berghei* did not differ significantly from that of the normal. The alkaline phosphatase activity also was not affected by the disease process. The glycogen content of the liver of *P. berghei* infected rats however was reduced in all the cases, being inversely proportional to the degree of parasitaemia. Histologically the normal liver did not show any gross abnormality. The liver tissue of *P. berghei* infected rats showed varying degrees of degenerative changes, melanism and round cell infiltration. Histochemically there was depletion of glycogen in the liver of infected rats but alkaline phosphatase activity was normal.

Probable causes of the normal amount of oxygen consumed by the liver of infected rats has been discussed. The depleted glycogen may be the result of breakdown of all available glycogen to glucose to meet the excess glucose in demand by the parasites. The normal alkaline phosphatase activity in the liver of infected rats indicate that the damaged liver cell still maintain some intact enzyme system which probably assist the regenerating process during recovery.

30. Culture and Experimental Transmission of M. leprae in Monkeys.

A. MUKHERJI, Lucknow.

(1) M. leprae has been successfully cultivated on a medium containing M. phlei, Lowenstein-Jeensen salt solution and whole eggs. (2) Leprosy has been successfully transmitted to monkeys by introducing the infective materials, culture and suspension of carlobe pieces from leprosy patients through the intraneural route in the left ulnar nerve. (3) The manifestations of leprosy were as follows: (i) thickening of the ulnar nerve in infected animals, (ii) presence of acid fast rods in various organs far remote from the place of inoculation, (iii) marked fibrosis in nerves specially the inoculated ones and in the spleen, (iv) reddish brown lesion in the skin over the nose, (v) Claw hand in the same side as the inoculated nerve. This however, was marked in one monkey only. In others it was not pronounced.

31. Determination of Blood Meals of Indian *Culicoides*.

P. SEN and S. K. DAS GUPTA, Calcutta.

Nature of blood meals in *Culicoides* collected wild from environs of Calcutta as also of preferential feed in laboratory bred specimens have been studied in fifteen species by precipitin tests. Out of the lot only one species which appears to be new to the science showed evidence of digesting human blood, and the rest proved positive for cattle blood with the exception however of *C. anophelis* which appeared to feed on tissue fluid of mosquitoes acting as ectoparasites. The last named species thus does not feed on stomach blood of mosquitoes as commonly believed.

32. Neurological Complication in Plasmodium gallinaceum infection.

N. K. ROY, Calcutta.

Studies on the progress of parasitemia in more than two thousands fowls show that birds between 50-10 g. weight rarely fail to develop blood induced *Plasmodium gallinaceum* infection. Birds of higher weight differ very much in taking up infection. About 18% developed scanty infection, responding differently to intravenous glucose. About 13% do not show parasitic growth in the peripheral blood. Birds not developing high parasitemia or not developing parasitemia at all, suffer most from paralytic complications of varying intensity. In some birds again, in which the parasitemia after usual progress gradually decline without treatment, spasmodic contraction more marked in the neck develop and gradually gains in intensity so much so that in some birds complete opisthotonic condition supervenes. During intervals of fits such birds behave, as if, quite healthy. Treatment for deficiency of riboflavin and pantothenic acid have been found useless. Vitamin B_1 given intramuscularly on the first appearance of spasm checks it, and even when given late relieves the complaint. Some of such treated animals lived well for months, but subinoculation in fresh animals from them, showed definite parasitemia in the recipient fowls.

33. Phage Typing in Cholera.

S. MUKHERJEE, Calcutta.

One hundred twenty strains of bacteriophages isolated from stools of cholera patients and lysogenic *V. cholerae* from epidemics in Calcutta could be classified into 4 groups by their patterns of lysis, action on phage-resistant secondary growths of vibrios and antiphage serum neutralization tests. *V. cholcrae* were typed according to their patterns of sensitivity to these 4 groups of phages. Five types were identified amongst the 200 strains of *V. cholerae* isolated in 1955-56; while one of the types could be classified into 3 sub-types by phage-adaptations. Compared to this 225 strains isolated in 1957 belonged to four of the phage-types. Type 1 was found to be the predominating phage type.

In 1957 there was marked rise in the incidence of group II phages along with type 3 vibrios. And over 72 per cent of the type 3 vibrios carried group II phages. Secondary growths resulting from the action of group II phage on type 1 vibrios were identical to type 3 vibrios in respect of phage sensitivity and degrees of S-R dissociations.

The possible role of group II phages in the genesis of type 3 vibrios in nature is suggested. Similar origins of other phage types are discussed.

34. Nucleic Acid Contents of *Escheichia* and their Relations to Bacterial Dissociation.

A. BANERJEA, Calcutta.

Sixteen serotypes of *Escherichia coli*, 0111B4, 055B5, 026B6, 086B7, 0119, 073, 076, 028, 06, 04, 02, N1, N2, N3, N4 and N5, were examined for their nucleic acid contents. The rough forms of 4 serotypes, 0111B4, 055B5, 026B6 and 086B7 were also examined for their DNA and RNA contents.

A wide range of variation in DNA and RNA contents were found in the smooth forms, the usual DNA content varied from 3·3 to 4·4 per cent of the dry weight of bacterial cells, and usual RNA contents from 12 to 14 per cent. The protein contents of these bacterial cells had no direct bearing on the quantities of DNA or RNA present in them. No distinctive features could be noted when the strains were grouped into pathogens, probable pathogens and non-pathogens as regards the production of infantile diarrhoea.

The examination of four serotypes of 0111B4, 055B5, 026B6 and 086B7 during smooth to rough dissociation revealed some correlation between the protein and nucleic acid contents of these serotypes. The protein contents decreased in the rough forms of 3 of the types, 0111B4, 055B5 and 086B7 and the RNA and DNA contents were also found to be decreased in these rough forms, the RNA specially showing a somewhat proportional decrease with the decrease in protein content. In the rough variant of 026B6, the protein content slightly increased and the DNA remained nearly stationary, whereas the RNA content was found to be much reduced.

35. Nutritional Studies on *Myco. tuberculosis* ($H_{37}R_V$). Influence of amino acids on the *in vitro* growth of *Myco. tuberculosis.*

Miss M. INDIRA, T. RAMAKRISHNA and M. SIRSI, Bangalore.

Although the amino acid requirement of the tubercle bacillus *in vitro* has been studied by a number of workers, still some doubt exists because of the conflicting results obtained by the authors in the case of arginine, leucine, proline, and also about the best combination of amino acids for the optimum growth of the bacillus. The present investigation was done to reanalyse all the facts regarding the action of some amino acids singly and in presence of aspargine. A new method of combining the amino acids was decided upon.

It was found that in the presence of asparagine, the amino acids di-methionine l-cystine, dl-phenylalanine, l-tyrosine, and l-tryptophane are inhibitory at high concentrations.

In the absence of asparagine also the above-mentioned amino acids were inhibitory. l-proline, hydroxy-proline, dl-isoleucine did not support growth very well. Arginine supported growth at low dilutions. The other amino acids supported growth in various degrees.

In combination, the basic and heterocyclie amino acide found in casein hydrolysate inhibited growth singly as well as in combination. The addition of either the neutral or acidic amino acids of casein hydrolysate singly or in combination to them ensures good growth. A mixture of all the four groups gives the best growth.

36. Response of Calcutta guinea pigs to experimental infection with *Mycobacterium tuberculosis.*

P. K. SANYAL and S. B. CHATTORAJ, Calcutta.

Guinea pigs have been reported to the highly susceptible to tuberculosis infection both by human and bovine type of the bacilli. As reported by foreign workers only a few bacilli are sufficient to induce an active and fatal infection in guinea pigs within a period of few weeks.

A suspicion was raised as to the validity of the foregoing observation as in our own laboratory, we had the occasion to infect some guinea pigs with tubercle bacilli of the bovine type in connection with an experiment with an indigenous drug claimed to have antituberculous properties. But considerable difficulty was felt as a large number of the above guinea pigs failed to take up an active and fatal infection

A total number of 16 guinea pigs of medium size and initially negative to tuberculin test (Mantoux method) when infected by the intraperitoneal route with a glycerine broth culture of the bacilli—½ mg. being the average dose into each. The observations were as follows :—

1. 2 of the animals died within a day or two before the infection was established due to unknowu causes. In one animal post mortem could not be done.
2. 3 animals died with evidence of generalised miliary tuberculosis and smears from the viscera showed plenty of tubercle bacilli.
3. In 3 animals which died, no pathological lesions in the viscera were seen macroscopically but the smears contained plenty of tubercle bacilli (Yersin type of infection).
4. The remaining 7 animals survived the infection. There was an initial loss with sickly condition but the animals later on gradually gained in weight and became completely healthy. The tuberculin tests were positive in all the animals. After 3 or 4 months they were sacrificed and a post mortem was done. The viscera all looked healthy and smears were negative.

From the above findings we may conclude that these 7 animals although they became infected initially, survived the infection and became as healthy as before. Whether the resistance of the local guinea pigs to tuberculosis infection is a racial one or whether this is due to an attenuation in the virulence of the local strain of the tubercle bacilli is a point which requires further study and elucidation.

37. Effect of Shell Oil of Cashew nut from different sources in human helminthiasis.

PROMODE K. SANYAL.

Shell oil of Cashew nuts has been proved to be a good anthelmintic for the treatment of various helminthic infection. In a preliminary report Bhaduri and Sanyal (1952) used the prepared oil for the treatment of roundworms as well as hookworm infection. The prepared oil was well tolerated and did not produce any toxic symptoms. They further reported (1953, 1954) that the oil exhibited anthelmintic action not only against the roundworm and hookworms but also against *Hymenolepis nana* and *Fasciolopsis buski* (a trematode). The oil did not appear to have any depressant action on the heart or blood pressure.

The cashew nut oil was extracted by various processes and subjected to different treatments to obtain different forms, of which the anthelmintic action on human patients were studied. In almost all cases the anthelmintic action was found to be good. Even raw cashew nut shell oil, which contains about 90% anacardic acid, was found to be effective though it was used only on 2 cases. The distilled fraction was also found to be effective. The phenolic portion (bicarbonate insoluble) of a sample of cashew nut shell oil prepared from commercially prepared form obtained from Midnapur district of West Bengal, was separated and was given for clinical trial which was found effective as an anthelmintic (*loc cit*).

It has also been observed that samples of cashew nut shell oil or extract from nuts received from various parts of the country exhibit the almost similar anthelmintic action.

The toxicity tests carried out on rats showed that the raw oil is very toxic while the prepared oil (heat treated) is not toxic. The pharmacological investigations also showed a marked difference on blood pressure between the two.

It has, however, been observed that the prepared cashew nut shell oil has no action against the mouse threadworms.

38. A Comparative study of leaves of Digitalis purpurea Linn and Digitalis lanata Ehrh.

PROMODE K. SANYAL.

There are several species of Digitalis leaves, available in the different parts of the world which are used medicinally in the same way as the leaves of *D. purpurea*. Out of these species *Digitalis purpurea* Linn and *Digitalis lanata* Ehrh, two species of therapeutic value have been introduced into India and are cultivated for medicinal purposes. They are now commercially grown in the Kashmir valley and in Darjeeling District of West Bengal.

The Indian Pharmacopoeia, British Pharmacopoeia, the United States Pharmacopoeia and also the International Pharmacopoeia use the leaves of D. purpurea only for the preparation of Tincture of Digitalis. It has been observed that the leaves of *Digitalis lanata* are being used to prepare the official Tincture of Digitalis.

The two leaves of *D. purpurea* Linn and D. *lanata* Ehrh can be easily distinguished morphologically when they are obtainable in larger sizes. But the drug of commerce is often obtainable in broken condition or in powdered form. The powdered leaves of the two species can well be distinguished by the trichomes present in two varieties. The *D. purpurea* leaves have two types of trichomes one of which are plentiful (a) three to five celled long, apex acute cell often collapsed and second not many (b) glandular trichomes, mostly with a short unicellular stalk and two celled heads, whereas the lanata leaves no such trichomes are present.

The two tinctures prepared from the two varieties of leaves may be distinguished by means of paper chromatography.

Biological Assay. It has been observed that when the leaves of *D. lanata* have been used to prepare the official tincture and when the potency is estimated by the standard B.P. method—the sample gives a result which is approximately 200 to 300 times stronger than the tincture made from purpurea leaves. In the absence of an International standard of *D. lanata* this potency, so estimated, is falacious. So, when *D. lanata* is used for the preparation of official tincture of Digitalis and the potency is estimated by the standard B.P. method, the therapeutic dose of that tincture so produced is definitely lower than the dose required.

39. Gaffkya Tetragena in assay of Antibiotics.

B. K. GHOSE and P. K. SANYAL.

During routine assay work on antibiotics difficulties were encountered in obtaining and maintaining certain official strains of micro-organisms. An attempt was therefore made to search for such bacterium of bacteria as would be equally useful for our purpose. Gaffkya tetragena was picked out from a host of other micro-organisms and a comparative study was undertaken with a few other official species to find out if it was suitable for estimation of antibiotic activity.

It was observed that Gaffkya tetragena treated in the same way as Staphylococcus aureus. B. subtilis and Sarciena Lutea produced similar or in same cases even zones of inhibition that the official strains mentioned above.

It was also observed that the zone diameters though larger in some cases were not so well defined on the same media under the same biological conditions. (Specially with Aureomycin and Streptomycin Gaffkya produced larger zones).

Gaffkya tetragena being so easily available and being usually non-pathogenic, it is expected that with slight modifications, it might prove to be a good substitute for some of the official species used for biological assays.

40. Cortisone in Cholera.

H. N. CHATTERJEE, Calcutta.

Cortisone was therapeutically studied in 12 acutely collapsed and pulseless cases of Cholera. The dosage was 50 mg. every 12 hours in the adult and 25 mg. in children given intramuscularly.

Cortisone seemed to have no advantage regarding the initial reappearance of the pulse and the time for the re-appearance of the previously vanished pulse was the same as that of controls numbering 21.

But during the latter part of the first day of hospitalisation, and hence onward, cortisone seemed to be of remarkable help and its action seemed to be more steady than that of the newer analeptics, in steadying the blood pressure.

Consequently it is suggested that in the more severe Cholera cases with advanced shock, the analeptics should be given in the early stages only and should be later supplemented by cortisone for rehabilitation of circulatory collapse.

Cortisone has also been seen to prevent the reactionary hyperpyrexia of Cholera, especially following the transfusions.

There were no relapses in our group of Cholera cases treated with cortisone.

There was only one case of fatality in a child of 3 years, the mortality percentage being 8·3% in contrast to 14% mortality of the controls.

41. Some Analeptics in the therapy of Severe Schock in Cholera.

H. N. CHATTERJEE & S. BHADRA, Calcutta.

The therapeutic effects of three new analeptic drugs in the treatment of pulseless and severely collapsed cases of Cholera have been studied side by side with the controls. Only cases which showed agglutinable Cholera vibrios in the culture of the stools have been taken into consideration and were 62 in number.

All these cases received the routine hospital treatment consisting of Coleus aromaticus, Avomine, saline transfusions etc. and in addition were divided into groups receiving the following analeptic drugs respectively :—

A. Carnigen (a mammalian organ extract plus racemic-P-hydroxy-phenyl-methyl-amino proponol-hydrochloride)
B. Syncalton (P-methylamino-ethanophenol-tartarate)
C. Corvasymton (1-P-oxyphenyl 2 methyl amino-ethanol-tartarate)

The quickest of these to restore the pulse and make it palpable was found to be Syncalton (3-5 minutes; 12 cases). The average time taken by Carnigen was 5 to 10 minutes (13 cases) and Corvasymton was 20 to 30 minutes (16 cases) to make the pulse first palpable.

In the control cases the average time for the first re-appearance of pulse was 1½ to 2 hours.

Syncalton seemed to be the most transient in its action, Carnigen second and Corvasymton the least. All the drugs had to be repeated during 72 hours.

The respective mortality rates were: Carnigen, 8·3%; Syncalton, 7·6%; Corvasymton, 12·5%; and controls 14·3%.

42. Frequency of 'A' and 'B' blood group secretors in Bengalees.

M. N. ROY and J. B. CHATTERJEA.

A total of 336 individuals selected at random from the professional donors and from patients in Carmichael Hospital for Tropical Diseases were examined. All the patients were Hindu males from Bengal. Their ages varied from 18 to 55 years. Employing the agglutination inhibition technique of Weiner, presence of 'A' and 'B' substances was detected in saliva treated with appropriate measures. The incidence of secretors in the series was 73·2% and of non-secretors 26·8%.

43. Problem of Differentiation between latent Syphilis and Biological false positive Reaction in Leprosy.

A. N. ROY.

Recognition of biologic false positive serologic tests for syphilis has become of great importance. This is more so in leprosy serum which shows a good percentage of B.F.P. reaction. Prior to the development of *Treponema pallidum* immobilization (TPI) test by Nelson, Neurath euglobulininhibition test provied one of the few possible laboratory control of the Standard Serologic tests for syphilis, from the point of view of biologic false positive tests. VDRL antigens also claimed to give few false positive reaction is stated to be not free from this drawback. Comparison of the results obtained by the Neurath test with those obtained by TPI test and standard serological test for syphilis made by Roy, Hill *et al* indicated that latent syphilis could better be detected by TPI test than standard serological method. Application of TPI test to differentiate between latent syphilis and biologically false positive reaction in leprosy is suggested.

44. The heart of the Indian Flying lizard, *Draco dussumieri* with special reference to the conducting system.

RAVI PRAKASH and S. C. RAGHAVAIAH, Bhopal.

In the heart of *Draco* sinuatrial node, atrioventricular bundle and ordinary cardiac fibres are present to constitute the impulse initiating and conducting (connecting) tissue. A single sinuatrial valve is present on the left side of the sinuatrial opening resembling that of fishes. There is an atrioventricular bundle present at the atrioventricular junction of the heart which has a triangular shape and gives out two branches like the bundle of His of birds and mammals. The probable path of the cardiac rhythm of contraction from sinus venosus to ventricle is described. Impulses initiated at and conducted by the sinuatrial node would pass to the atrioventricular bundle through the left sinuatrial valve and the interatrial septum which in turn would transmit them to the ventricle through its two branches. The myogenic theory of cardiac conduction is supported. It is argued that the impulse conducting tissue of the heart of birds and mammals has evolved from that of lower vertebrates.

45. The Heart and its Conducting system of the Indian House Sparrow *Passer Domesticus*.

RAVI PRAKASH and RAJ KRISHNA KHANNA, Bhopal.

The minute anatomy of the heart and its conducting tissue in the house sparrow *Passer domesticus* has been studied and described. Two distinct portions have been observed within the right atrium, and have been referred to as sinus venarum and the right atrium proper. The sinus venarum and a pair of sinuatrial valves through which it opens into the right atrium proper, represent the incorporated sinus venosus of lower vertebrates. It is argued that in the absence of any valve at the opening of the two precaval veins into the sinus venarum portion of the right atrium, the sinuatrial valves help to prevent the back flow of blood into the precaval veins during atrial systole. It has been observed that a sinuatrial node, an atrioventricular node, an atrioventricular bundle and Purkinje fibres form a continuum to explain the existence of well defined impulse initiating and conducting tissue in the heart of these birds.

46. On the Presence of Specialized Conducting (Connecting) Tissue in the Crocodile Heart.

RAVI PRAKASH and SATISH CHARAN MOWAR, Bhopal.

The heart of *Crocodilus porosus* has been studied with special reference to its conducting tissue. Sinuatrial node and atrioventricular node have been observed for the first time in crocodile heart. It has been observed that the sinuatrial valves do not connect the sinus venosus with the atria as they are formed off atrial musculature only. The cardiac stimulus of contraction is believed to be initiated at and conducted by the sinuatrial node from the sinus venosus to the two atria. An atrioventricular node, formed of closely interwoven muscle fibres showing deeply stained large oval nuclei with a clear perinuclear space, has been observed in the caudal portion of the interatrial septum. Sinuatrial and atrioventricular nodes are connected through Purkinje fibres as well as through ordinary cardiac tissue. The presence of nodal and Purkinje fibres in the crocodile heart is unique and hitherto unrecorded feature. The evolution of the impulse initiating and conducting tissue of the heart of birds and mammals from that of lower vertebrates has been discussed.

47. On the Presence of Specialized Conducting (Connecting) Tissue in the Heart of Guinea Pigs.

RAVI PRAKASH and S. P. BHATNAGAR, Bhopal.

The minute anatomy of the tissue that connects the various chambers of the heart of guinea pigs has been studied in the serial sections. The non-existant muscular conduction system of Glomsets has been observed to exist in the heart of these mammals. To initiate the cardiac stimulus of contraction a sinoatrial node is present near the opening of the superior vena cava into the right atrium. An atrioventricular node and an atrioventricular bundle are present at the atrioventricular junction of the heart to control and conduct the cardiac stimulus of contraction from the atria to the ventricles. The interatrial septum has been held to be responsible for conveying the contraction stimulus from the sinoatrial node to the atria and the atrioventricular node. The sinoatrial and the atrioventricular nodes and the atrioventricular bundle are formed of histologically specialized fibres (Nodal and Purkinje fibres) but they are connected with each other through ordinary myocardium of the heart. It is argued that the impulse initiating and conducting tissue of the heart of mammals is formed of both specialized and unspecialized muscle fibres. The myogenic theory of cardiac conduction is supported.

48. Comparative toxicity study of pasinide—isonicotinyl hydrazide—para-amino salicylate and isoniazide.

SRIPATI BOSE and A. N. BOSE, Calcutta.

Recently considerable attention has been given to a molecular compound of I.N.H. and P.A.S. (Isonicotyl hydrazide para-amino salicylate, pasinide) in the treatment of resistant cases of pulmonary tuberculosis. Considering the compound to be a salt of isoniazide, it was considered to be of interest to study how far the toxic properties of I.N.H. are modified in the combination. Accordingly determination of acute toxicity on white in-bred mice was done with I.N.H. and Pasinide. The subcutaneous LD_{50}s of pasinide and I.N.H. were found to be 0·39 mg/gm and 0·204 mg/gm respectively.

Chemically 1 gm of pasinide contains 0·47 gm of I.N.H. Because the toxicity figures of the two compounds also come up to the same ratio, it is concluded that the formation of the salt has not altered the toxic potentiality of the compound more than what was expected from its molar equivalence in relation to I.N.H.

49. Clinical observation on the Antispasmodic and Acid-neutralising properties of a Piperidino-Methyl Pyrazolone Derivative (ASC—I) alone and in combination with a Antacid.

A. N. BOSE and A. Roy, Calcutta.

In a previous communication (Bose and Bose, *Proc. Ind. Sci. Cong.* Part III, 1952) it was reported that the compound, 1-phenyl-3-methyl-4-piperidinomethylpyrazolone possesses a significant spasmolytic anti-cholinergic activity, which was both musculotropic and neurotropic in origin. Considering the low toxicity, and the slow absorption of the compound which is likely to cause a high local concentration in the gut, it was considered to be of interest to study the compound clinically on some patients suffering from spasmodic conditions of the gastro-intestinal and biliary tracts.

Fourteen cases of spasm originating in the intestine, gall-bladder and diaphragm were first treated with the compound alone, in a dose of 0·25 g thrice daily. The observations revealed that the compound, while failing to act significantly on the gall-bladder spasms, could effectively relieve the spasms associated with the gastro-intestinal tract. It could also reduce the pain and hyperacidity of peptic ulcer cases to some extent, though its anti-cholinergic activity with regard to gastric secretion, was weaker in comparison with atropine. In peptic ulcer cases with high acid curves, the compound alone failed to relieve the pain. With the purpose of exerting both anti-spasmodic and antacid properties, the compound, therefore, was combined with 0 5 g of magnesium aluminium silicate in tablet form and studied on eighteen cases of radiologically diagnosed peptic ulcer with severe hyperacidity. The results show that the combination of 1-phenyl-3-methyl-4-piperidinomethylpyrazolone with magnesium aluminium silicate causes a more effective relief of pain, and more prolonged control of hyperacidity in peptic ulcer cases than those by either atropine or any other antacid.

50. Abstract of Sexual Rhythm in Cows.

R. VEERAMANI AYYAR, Izat.

The paper lays emphasis on the observed facts that the sexual rhythm in cows (oestrus) though influenced by many factors like season, environment, management etc., is most strikingly influenced by the phases of the moon. The more moon lit days or more dark days i.e., a few days prior or a few days following new or full moon (called now as full moon week or new moon week) bring in more cows in physiological fertile oestrus than in partial moon lit days.

Figures in support of the above are given in the detailed paper.

51. Abstract of Sexual Lethargy in Breeding Bulls.

R. VEERAMANI AYYAR, Madras.

The article aims at focusing the intricate importance of water in the dietary of breeding bulls at stud. The regular and systematic management without proper care to the water supply brings in the slowness in service (lowering of sexual smartness) now named as sexual lethargy.

By excess intake of water, the water gets stored in body cells as hydrol-di or tri, and this in the presence of enzymes inactivates the androgens. This inactivated androgen "KETOSTEROIDS" being soluble in water are eliminated through the kidneys bringing the level of the physiological steroids (androgens) circulating in the system very low. This reduced level of androgen brings about the sexual lethargy.

Thus if the water in-take is reduced in such bulls the optimum androgen level is re-established making the bull smart again sexually.

52. Colposcopy in Gynaecological Examination.

MELBA KAMAT, Bombay.

It is an accepted fact in clinical practice that malignancy seldom develops in normal tissue. For this reason, every clinician aims to diagnose and treat lesions at an early stage.

The C.T.U. working the I.C.R.C. follow the investigative methods of colposcopy, cytologic smear and biopsy (when necessary) on every women coming to the clinic, and the practice has been followed since last year.

These methods have proved their usefulness in routine gynaecological examination. A few cases of early cervical cancer have been diagnosed. It is the purpose of this paper to outline the importance of colposcopy in gynaecology in general and its great value as means of detecting minute changes on the vaginal and cervical mucosa.

Colposcopy has been ignored in India, but has found wide use in South America and Europe. There, in most of the gynaecological clinics, colposcopy is a part of routine pelvic examination.

The great advantages of colposcopy are recognised everywhere, and as Wespi points out—"vaginal smears and multiple biopsies are a sort of fishing in murky water, colposcopy is shooting in good light".

53. Abortion in goats caused by B. Coli.

M. S. DAS and G. K. GHOSE, Calcutta.

From a case of abortion in a Jamnapari goat, brought to the Bengal Veterinary College Hospital, an organism of Coli type was isolated in pure culture. Later on the organism was tested for its virulence in pregnant rabbits and guinea pigs. In the rabbit it produced signs of abortion followed by death of the animal. The organism was selectively present in the uterus but there was no evidence of the organism being present in the heart blood. The rabbit died after showing signs of straining as if to deliver the litter. There was severe vaginal haemorrhage. These started 18 hours after inoculation with the test organism. On p.m. examination uterine cavity was found to be filled up with a large lump of clotted blood. Guinea-pigs have so far been found to be refractory.

54. Gastroenteritis in young calves—a bacteriological study. I. Salmonella Infected Cases.

S. S. KHERA and M. R. DHANDA, Mukteswar-Kumaon.

An investigation into digestive diseases of young calves, which are responsible for a large proportion of early calf deaths in this country, was carried out at three farms in two States, namely, Bombay and Uttar Pradesh. In 191 buffaloes and cow calves that died within three months of birth, infection with various members of Salmonella group was encountered in 74 cases. The different types isolated were *Salm. dublin* from 45 cases, *Salm. typhimurium* from 11 cases, *Salm. enteritidis* from 4, *Salm. weltevrden* from 5, *Salm. newport* from 2, *Salm. richmond* from 2, and *Salm. chester, Salm. pomona, Salm. nchanga, Salm. butantan* and *Salm. hvittingfoss* from one case each. It was observed that Salmonella organisms could be isolated with greater ease and in pure culture from mesenteric lymph nodes and spleen as compared to intestinal contents. In this limited number of cases studied, infection with Salmonella organisms appeared to be responsible for deaths more frequently in calves older than the age of two weeks.

In an attempt to trace the source of infection for calves, faecal samples of 100 cows and 100 buffaloes at one farm and 100 buffaloes at another were examined for faecal excretors. As the first farm 4 cows and one buffalo were found to excrete three different types of salmonella. All the three types, i.e., *Salm. pomona, Salm. richmond* and *Salm. hvittingfoss* have been recovered from cases in calves.

The importance of isolation of such a variety of Salmonella types from calves is discussed from public health point of view.

55. A Preliminary Note on Some Observations from Certain Types of Liver Extract.

A. N. BOSE and A. ROY, Calcutta.

A whole proteolysed liver extract and some different fractionated preparations of it were subjected to some clinical trial in twenty one cases of macrocytic anaemia. In some of the cases treated with fractionated preparations, a depression of haemopoiesis during the first week was noticed; but no significant alteration in the white cell series was observed. The behaviour with other fractions and the effect of the same on the patients have been discussed.

56. Intestinal Trichomoniasis.

J. K. MOHANTY and B. N. DAS, Orissa.

Trichomonas hominis inhabits the human intestine and is commonly present in the caecum and the colon. The consensus of opinion is that this flagellate is not pathogenic and it never invades the intestinal mucosa producing lesions thereon. But the evidence collected by the authors in a series of cases is strongly suggestive of its pathogenic role. They are of opinion that intestinal trichomoniasis gives rise to a diarrhoeic syndrome which has its own peculiar features. They selected for their study only pure and uncomplicated cases of trichomonal infection of the intestine and have very carefully excluded cases in which there was even remote possibility of latent intestinal amoebiasis, giardiasis or balantidiasis. These cases of trichomonal diarrhoea did not respond to adequate doses of emetine given parenterally but responded readily to the trichomonicidal drug, Iodochlorhydroxyquinoline. This drug is also not effective in giardiasis and balantidiasis. They have described in detail the symptom -complex met with in intestinal trichomoniasis. Further work, both clinical and experimental, is in progress.

57. Therapeutic use of Emetine in Leucoderma in Tropics.

K. C. SAHU, Cuttack.

Leucoderma is an annoying, disfiguring and degrading disease in our society prevalent in the Tropics. The cause for the functional disturbance of melanoblasts is unknown. In India, it has been observed that in the majority of cases there is some definite evidence of intestinal infection, specially and not infrequently it is associated with chronic intestinal amoebiasis. In these cases, with change in the bacterial flora of the gut associated with amoebic infection, the precursors for which the melanin of the body is ultimately produced are absent and hence leucoderma results. In 10 cases where no result has been obtained by investigating stool nor any tenderness felt on right iliac fosa or hypochondriac region, a course of Emetine hydrochlor gri every alternate day for 10 such has produced very good result, most of the patches of leucoderma being vanished.

58. Role of Para-aminobenzoic Acid in Premature Greying of Hairs.

K. C. SAHU, Cuttack.

Para-aminobenzoic Acid is a factor of Vitamin B complex. It is a part of the molecule of folic acid. This substance was first recognised as a vitamin by Ansbacher. He fed black and piebald rats on a diet which produced greying of the fur, a condition known as achromotrichia. When this diet was supplemented daily by 3 mg. of p-aminobenzoic acid, the animals grew normally pigmented fur within a month.

Basing on this p-aminobenzoic acid was used for premature greying of hairs for about one year in 20 cases of human achromotria, who attended the Skin and V. D. clinic of S. C. B. Medical College Hospital, Cuttack. It was given for a prolonged period of 2-3 months. Though the results were not uniform, the hair showed a tendency to return to the original colour and lustre in some cases and in some cases good results were produced.

59. "Clinical observations on the use of Undi oil (Calophyllum inophyllum Linn) in Dermatological practice."

K. C. SAHU, Cuttack.

Undi oil is chiefly obtained from South Kanara and Madras state. It is a greenish coloured oil of Calophyllum innophyllum Linn. It has got a refractive index at 32, 1·4730; iodine value, 92·3; saponification value 197·1. It has shown marked anti-bacterial activity in vitro against gram-positive organisms. This has been given clinical trials in twentyfive cases of skin diseases; Barber's itch, Impetigo, Psoriasis with secondary infection, Pyoderma Eczema with secondary infection, Herpes with secondary infection etc in the skin disease clinic of S. C. B. Medical College, Cuttack. It has been found a useful drug in such cases.

60. Radiotherapy in Dermal Leishmanoid and Oriental Sore.

S. P. BASU, Calcutta.

Ninety six cases of Dermal Leishmanoid (DL) and twenty-one cases of oriental sore were treated with radiotherapy. Two types of DL were treated, viz. the nodular and the hypopigmented macular types. All cases of DL were given a total of 300-350 r divided into six doses bi-weekly. The factors used were 100 KVP., 5 M.A., 1 M.M., AL filter, 30 c.m. distance. A few oriental sore cases were given harder rays by increasing the intensity and altering the filtration.

The hypopigmented areas grew darker during the course of the treatment due to photosensitive effect on the skin. The hypo-pigmentation returned as soon as the blackening was over.

The nodular lesions regressed very slowly if at all when compared with extent of treatment. Oriental sore cases also had the same fate unless aided by specific drugs. Radiation alone in the region of 2,000 r failed to produce any beneficial effect on oriental sore.

61. Intestinal Parasitic Infection and Duodenal Ulcer Syndrome.

S. P. BASU and A. K. BHATTACHARYA, Calcutta.

The present communication deals with the analytical results, (both clinical and radiological) of barium meal examinations of (a) 88 cases of diagnosed duodenal ulcer, (b) 10 of 'duodenitis' and (c) 35 of chronic intestinal amoebiasis. The patients of the last group complained mainly of vague abdominal pain, discomfort after food, flatulence, acid eructations etc., and *E. histolytica* was found in the stools of all of them.

Thirty-one of the group (a) had parasites in the stools, (*E. histolytica* in 3, giardiasis in 11, ascaris in 7 ankylostomiasis in 10, a few having double infection). Five of (b) had giardiasis only, while as many as 12 of the last group (c) had radiological evidence of duodenal ulcer. It was observed that hyperchlorhydria was not the usual feature in these cases and the symptoms were often relieved by specific treatment for the parasites. Possibility of parasitic infection of the bowel giving rise to duodenitis, duodenal ulcer or ulcer syndrome in the tropics is indicated by the present observations.

62. Clinical experience with oral antidiabetics.

P. MITRA, and N. SANYAL, Calcutta.

Oral antidiabetic drugs (carbutamide and tolbutamide) were subjected to clinical trial on forty-one elderly diabetics without complications, the duration of illness varying from 1 month to 17 years and who had little or no insulin previously. Before the trial of the drug all were maintained on a suitable dietary regimen. It was used in the form of tolbutamide (local as well as foreign product) in 22 cases and carbutamide in 19 cases, the dosage being 3 gm. on the 1st day, 2 gm. on 2nd and 3rd day in divided doses followed by a maintenance dose of 0·5 to 1·5 gm. per day for a period varying from 3 to 6 months. The response was quick, the urine being free from sugar in a few days and blood sugar restored almost to normal level within a week in 13 cases and two to three weeks in 12 cases, while 6 patients who had little or no response were switched on to insulin with ready response. 22 cases having the maintenance dose were followed up for 3 to 6 months; the improvement was maintained in about three-fourths of them and even with discontinuance of drug in 3 cases. Untoward reactions were encountered in three patients after a varying period of 10 days to six months. They were in the form of rash, urticaria, dermatitis and leucopenia, all being in the carbutamide group.

63. Incidence of spirochaetes in tropical eosinophilia.

R. N. CHAUDHURI, M. N. RAI CHAUDHURI, T. K. SAHA and
P. SEN, Calcutta.

The mucus obtained from bowel wash and sputum of 55 cases of tropical eosinophilia, before treatment, was examined by Fontana's silver staining method. Spirochaetes were detected in 45 specimens of bowel mucus and 43 specimens of sputum while in a series of control cases they were present in only 61 out of 128 bowel wash and 19 out of 37 samples of sputum examined. The spirochaetes in the bowel wash conformed to the description of those found there normally, but those from the sputum did not resemble *Spirochaeta bronchialis*; they were small and slender, always found incorporated in mucus, often in large numbers, but seldom free indicating that they multiply in mucus. They may be ordinary mouth spirochaetes which have extended their habitat to the bronchial mucous membrane and may have nothing to do with the disease, unless it is postulated that saprophytic spirochaetes transferred to a new site may cause abnormal reactions. Sputum of 21 eosinophilia cases was also examined after treatment. The number of spirochaetes was reduced in 14, unaltered in three, while four had none as compared to previous findings.

64. Spleen Extract.

R. N. CHAUDHURI, T. K. SAHA, B. BANERJEE and S. MUKHERJEE, Calcutta.

Acetone extract of bovine spleen was prepared in the laboratory and evaluated clinically in urticaria, bronchial asthma and tropical eosinophilia. It was administered by intramuscular injection, starting with a dose of 0·5 c.c., and increasing gradually to 2-3 c.c. for a total of 10-15 injections. Cases of urticaria showed variable improvement, a number of them being completely relieved during the period of observation for 3 months. Others had little or no improvement.

65. Tropical eosinophilia—sensitivity to parasitic antigen.

R. N. CHAUDHURI and T. K. SAHA, Calcutta.

Intradermal tests with antigen prepared from *Dirofilaria immitis* was done in 23 cases of tropical eosinophilia with eosinophil percentage varying between 35 and 85 percent. All showed positive reactions characterised by rapidly forming wheal of 18-30 mm. in diameter with pseudopodea surrounded by erythema, the reaction being maximum in about 10-15 minutes and disappearing in about 3 hours. In five cases the test was repeated 15 days after treatment with hetrazan; they were all positive as before treatment. Eight subjects of whom five had microfilaria in blood were also tested for comparison. All of them gave negative reaction except in one case of filariasis showing moderately positive reaction.

Intradermal tests with hookworm antigen and hydatid fluid were also done in 11 cases of tropical eosinophilia with suitable controls. With the former all were negative whereas moderately positive reaction was obtained with hydatid fluid in six. Control cases were all negative.

66. Field Survey of Eosinophilia.

R. N. CHAUDHURI and T. K. SAHA, Calcutta.

A survey of eosinophilia was carried out on subjects selected at random in Goalpara district (Assam) and Jalpaiguri, Hooghly and Nadia districts (West Bengal).

In Goalpara blood of 530 members of all age groups was examined both for absolute eosinophil and differential count. 80 cases had eosinophil count above 20% up to a maximum of 74%, the highest incidence being noted in young age groups. It is usually held that pulmonary manifestations of tropical eosinophilia are apt to occur in subjects having an absolute count above 2000/c.m. In the present study, thirty-two cases were encountered in whom the absolute count was between 2000-3000 in 24; 4000-5000 in 6; 5500 in one and 15200 in the remaining case. None of them showed obvious pulmonary manifestations.

In Jalpaiguri, 124 town dwellers and 504 villagers from adjacent areas were examined. Night blood was collected for micro-filaria as well as for differential count in each subject. Eosinophil count above 20% was detected in 115 out of 628 cases, 23 having a count of 30% and above up to a maximum of 64% without any lung symptoms. In 39 cases microfilaria was found in blood of whom only six had eosinophil count above 20% but not exceeding 30%. In one village there was high incidence of both filaria and eosinophilia (12·9% and 27·4% respectively), but none had both in common. In another village of 99 members, 32 individuals showed eosinophils above 20%, while microfilaria was found in one case only. These do not indicate obvious association of high eosinophilia with filarial infection. Failure to demonstrate parasite does not of course exclude the infection.

330 persons of all age groups in Hooghly area and 336 boys between 9 and 19 years in Nadia area were examined for differential count of blood. 89 cases in the former and 55 cases in the latter group showed eosinophils above 20% up to a maximum of 50%; of them 63% and 30% of the subjects respectively were aged 15 years or below. None of them showed any pulmonary manifestations.

67. Post-malarial Splenomegaly—an experimental study.

R. N. CHAUDHURI and T. K. SAHA, Calcutta.

Experiments on rats having repeated *P. berghei* inoculations without treatment were carried out along with suitable groups having antimalarial treatment after each inoculation, the period of observation being 1½ to 2 years. Rats for the former group were the immune ones that survived the initial *P. berghei* inoculation without treatment, but sub-inoculation of their blood to fresh mice was invariably positive.

Considerable enlargement of the spleen followed repeated *P. berghei* inoculations left without specific treatment. Significant pathological changes viz., foci of necrosis of liver cells with round cell infiltration of the necrosed areas and of the portal tracts were also observed. Parenchymal degenerative changes and fibroblastic proliferation were more marked in rats kept on protein-deficient diet than on normal diet. Initial deposition of malarial pigment ultimately disappeared in spite of repeated inoculations. Control rats which were given treatment showed no significant splenic enlargement or hepatic involvement. These experimental findings are somewhat similar to these observed clinically in chronic splenomegaly frequently encountered in rural areas and usually designated as tropical or Bengal splenomegaly, thus indicating that chronic malarial infection, untreated or inadequately treated, plays an important part in its causation, while malnutrition enhances the hepatic damage especially in the younger age group.

68. An incidence of Rinder pest in the College herd, Sabour, and some notable reaction due to vaccination with Freeze dried G.T.V.

B. M. LAHIRI, Sabour.

Outbreak of Rinderpest was noticed in the neighbouring villages of the College dairy farm at Sabour, which was free from it so long, for the last 15 years. To prevent infection spreading into the herd, the College herd, other than the milch animals (cows and buffaloes) and the working bullocks were vaccinated with wet G.T.V. manufactured at Patna Vety. Lab. The milch animals and the bullocks were inoculated with serum only. The bullocks were subsequently vaccinated with G.T.V. After nearly a month, 4 of the serum inoculated animals (milch buffaloes) were attacked with diarrhoea. One of them showed typical rinderpest lesions. The whole herd was revaccinated with Freeze dried G.T.V., an I.V.R.I. product. Following revaccination there were severe reactions in some of the vaccinated animals. The reactions were almost in the appearance of the actual disease itself, causing 3 deaths and 12 abortions. Other vaccinated milch animals showed con-showed considerable decrease of milk yield. There was no case of death in the bullock herd.

It indicated that the Freeze dried G.T.V. is a much stronger potent vaccine than the G.T.V. manufactured at Patna, but it is to be used with sufficient precautions. Preinoculation with ordinary A.P. serum given in high doses had no appreciable effect in controlling the severity of reactions produced by the Freeze dried G.T.V.

SECTION OF AGRICULTURAL SCIENCES

President :—DR. P. N. BHADURI, PH.D., F.N.I., F.L.S.

Abstracts

GENERAL

1. Comparative Studies on the genesis of sperms in the pollen tubes of two cultivated Jute species.

R. M. DATTA, Calcutta.

The tube nucleus generally precedes generative cell; sometimes follows it. In the generative nucleus chromatin matters of different size and shape are noticed in the form of chains, globules, streaks, etc. They are regarded as excess amount of heterochromatin connecting homologous euchromatic regions. Chromosomes divide equationally and extra chromosomes and heterochromatin are thrown out in the cytoplasm in course of division. Clear spindle is found. Cytokinesis takes place by furrowing. Sometimes more than two sperms are noticed.

2. Origin and distribution of the cultivated Jute species.

R. M. DATTA, Calcutta.

There are 92 valid species of *Corchorus* at present existing in the World. From the distribution of various valid species in the different parts of the World, the migrational, cytotaxonomical and inter-specific crossing evidences, the geology and climate (past and present) of the earth etc., it seems evident that *C. olitorius* is an immigrant to India from Africa and not a native of this place. *C. capsularis* seems to be a native of Eastern India (likely Bengal-Assam region). Wegener's theory of Continental Drift can explain away the present distribution of the genus.

3. Wild Ramie *Boehmeria platyphylla,* D.B. from Western Ghats—a possible source of Textile Fibre.

G. B. DEODIKAR and S. D. PATWARDHAN, Poona.

Boehmeria platyphylla D. B. is a highly variable polymorphic species widely distributed in India and adjacent countries. From the polymorphic mixture of this species, growing along the western slopes of the Mahabaleshwar Plateau (4500 ft.), stem bast fibres were extracted by raspedor. The crude extract was degummed and bleached yielding fine, strong, lustrous fibres (5% on air dried stems), 9 to 18 microns in diameter and consisting of either flat twisted ribbons or hollow medullated tubes with nodal swellings, lateral projections, tapering ends and smooth or rough topography. Test report from Jute Technological Research Laboratory, Calcutta shows it to be somewhat inferior to cultivated ramie fibre from *B. nivea.*

Polymorphic *B. platyphylla* shows botanical mixture, thus providing scope for selecting types approaching quality attributes of *B. nivea* fibres.

B. platyphylla survives through summer drought which *B. nivea* cannot tolerate under Mahabaleshwar conditions, unless irrigated. It may be possible to cultivate *B. platyphylla* as a purely rainfed perennial crop giving one or two cuttings during monsoon to winter and surviving through summer dormancy.

4. Poisoning of Honeybees foraging on *Euphorbia geniculata*, Roxb.

G. B. DEODIKAR, C. V. THAKAR, R. P. PHADKE and P. N. SHAH,
Mahabaleshwar.

In an experimental apiary (Ahmednagar district, Bombay State), large-scale deaths of bees were reported during the month of August in the year 1955-56. On closer observation it was found that the symptoms did not tally with any of the known bee diseases, and hence plant poisoning was suspected.

Pollen collected in the brood cells, the baskets and the alimentary canal of dying bees showed predominance of certain pollen type. The pollen was subsequently identified as that of *Euphorbia geniculata* a weed flowering profusely during that period. Similar instances of plant poisoning due to nectar or pollen have been cited.

Pollen grains of *Euphorbia geniculata* can be identified by their following morphological characteristics : Pollen grains spherical with colpar flattening, tricolpate, triporate, colpi longitudinal, extending half way between poles and equator, germ pores bearing convex bulge, equidistant and equatorial in position; colpar margin granular; intercolpar exine bearing reticulate or cellular markings with finely granular outline; cellular markings around colpus pallisade; mean diameter 45·39 microns.

5. Foraging of Honeybees on fungal rust spores of *Cystospora oleae*, Butler, on *Olea dioica*.

G. B. DEODIKAR, C. V. THAKAR, P. N. SHAH, S. R. SALVI and P. S. CHITALE,
Mahabaleshwar.

January and February mark a period of acute bee-forage scarcity in the annual floral cycle at Mahabaleshwar (4500 ft.) in Western Ghats.

Routine analysis of pollen load sampling at weekly intervals during the annual floral cycles for the years 1954, 1955 and 1957 revealed that loads during January and February mainly consist of spores, conspicuously differing from typical pollen grains, by absence of colpar furrows and germ pores. Tracing their source, bees were observed foraging on rust spores on the leaves of *Olea dioica*. These spores were identified as aeciospores of *Cystospora olea*, Butler.

Nilgirianthus heyneanus, var Neesii, Bremek. (Acanthaceae), flowering triennially, bloomed during January and February 1956 providing ample nectar and pollen and these rust spores were not represented in the load samples normally expected during this scarcity period.

Bees therefore, forage on *Cystospora* aeciospores during acute scarcity without apparent ill effects but neglect these in preference to normal pollen if available.

Yeast spores (*Saccharomyces* and *Torula* species) contaminating the floral nectars are *incidentally* carried by foraging bees. But instances of bees *deliberately* foraging on fungal spores are extremely rare there being only one case reported by Maurizio from Switzerland, of bees foraging in *Uredineae spores*.

6. A note on the introduction of Sea Island Cotton in India.

N. KESAVA IYENGAR, Coimbatore.

The note deals with the Scheme of Sea Island Cotton Cultivation, on all India basis, in the three States of Kerala, Mysore and Assam. According to the Scheme the prolific superfine cotton, Andrews, is to be cultivated over an area of 3 lakh acres and produce 2·25 lakh bales every year. When this is materialised, foreign exchange to the tune of 30 crores of rupees and above will be saved every year. Researches on breeding, agronomy and technology and also extension are in progress from 1957-58. Emphasis has been placed on the careful cultivation of the crop in heavy rainfall tracts receiving 90″ or more of rain per year, on soils which are lateritic and characterised by good drainage. A nett profit of Rs. 400-500, per acre, is obtained by this cotton, raised purely as a rain grown crop.

7. Morphological and Physiological changes associated with the change in cotyledon number in certain Angiosperms.

B. MISRO and D. N. ROY, Bhubaneshwar.

The occurrence of seedling with varying number of cotyledons (e.g. one, three or four) is not uncommon in a dicot population. The present account deals with the behaviour of monocots, tricots and tetracots obtained in a dicot population of niger (*Guizotia abyssinica*).

In the monocot seedling, the internode length was much reduced, the leaves were in such profusion that the plant looked bunchy. There were abundant flowers, but no seeds could be obtained.

In the tricot seedling, at each node there were three-leaved whorls instead of the usual opposite and decussate arrangement. This phyllotaxy change was, however, confined to the main axis and was not met with in the axillary shoots. There was reduced seed-setting in the tricots.

In the tetracot seedling, at each node there were four leaves on the main axis, instead of the usual two. There was reduced seed-setting in the tetracots also.

As the cotyledon formation occurs in the post-embryonic development and is not hereditary, it is concluded that the occurrence is due to extra-nuclear causes, possibly of cytoplasmic origin.

8. Pollen grain studies in various types of *Corchorus, C. olitorius L., C. capsularis* and some other species of Corchorus.

G. I. PATEL, Vittal, and R. M. DATTA, Calcutta.

Fertility percentage of pollen grains in thirty one types of *C. capsularis*, eight types of *C. olitorius* and six other different species of *Corchorus* has been worked out. Measurements of the pollen grains of three types of *C.* olitorius, ten types of *C. capsularis* and five other species not reported before, are given. Those of others were already reported by Datta (1956).

After performing the test of significance by analysis of variance, it is noticed that there exists real variation amongst species studied. Intergradations are noticed showing evolution of the genus to be of divergent type, though in one direction, as shown by similar type of pollen morphology in all the species studied.

Meiotic lability recorded for the first time in different *Corchorus* species by Datta (1952, 1953 and unpublished) very likely reflects on the grain size.

9. Studies in the storage of edible Vegetable Oils with especial reference to Packaging and Transportation.

M. PRASAD and P. B. MATHUR, Mysore.

Separate lots of eight vegetable oils, viz., castor, coconut, mustard, olive, peanut (crude), peanut (refined), sesame and "Vanaspati" were packaged in colourless and green glass battles and stored at 71-93°F for 2 years and at 138-142°F for 35 days. It was found that yellow pigments are weaker pro-oxidants, weight for weight, as compared to the anti-oxidant activity of red pigments. It is concluded that by adjusting the proportions of yellow and red pigments in an oil it may be possible to avoid the use of green glass containers altogether.

10. Weed flora in Jowar fields.

R. BANER RAJ, SYED VAHEEDUDDIN and V. RAVINDRA NATH,
Rajendranagar.

Survey was undertaken to know the weed flora that is commonly found in jowar field before actually testing some weedicides for their control. Crop growth in both the growing seasons i.e. Kharif and Rabi were also kept under observation in a replicated trial at Rajendranagar Farm for the past 5 years. Weeds were collected and identified. In addition to 24 weeds reported by Syed Vaheeduddin and M. S. Varsi (Proc. 41 s. Ind. Scie. Cong. 1954. Hyderabad Dn.) 26 more new weeds are reported belonging to 9 dicot and 3 monocot families. The list of 26 weeds is given below :—

1. *Alysicarpus monilifera.*
2. *Digera arvensis.*
3. *Desmodium gangeticum.*
4. *Crotalaria verucosa.*
5. *Borreria hispida.*
6. *Phylanthus polyphyllus.*
7. *Euphorbia ethymoides.*
8. *Cocculus villosus.*
9. *Indigofera glandulifera.*
10. *Cardiospermum halicacabum.*
11. *Sclerocarpus africanus.*
12. *Phaseolus trilobus.*
13. *Leptadenia reticulata.*
14. *Chrozophora rottleri.*
15. *Hibiscus vitifolius.*
16. *Sida acuta.*
17. *Sida cordifolia.*
18. *Sida glutinosa.*
19. *Sida spinosa.*
20. *Indigofera linifolia.*
21. *Acacia arabica.*
22. *Echinicloa colona.*
23. *Cyperus rotundus.*
34. *Digiteria sangunalis.*
25. *Cynotis axilaris.*
26. *Crotalaria juncea.*

AGRONOMY

11. Germination and Vigour of seedlings as influenced by the quality of Seed-Arecanut (*Areca catechu* Linn.).

K. V. AHAMED BAVAPPA, G. I. PATEL and K. SHAMA BHAT, Vittal.

Preliminary studies were undertaken to find out the the influence of the quality of seed arecanut on the germination and vigour of seedlings. It was observed that there existed wide variability in the initiation and progress of sprouting. The extent of the variability was determined and the factors like heterogeneity of the material, parental tree characters like high yield, high female flower production, high nut set, size and weight of nut etc. which may influence it, discussed. The average seednut germination percentage was observed to be 94·7 ± 0·81 and the mean number of days required for starting germination and for its completion were found to be 53·0 ± 0·68 and 94·0 ± 2·25 respectively. The factors responsible for the failure of seednuts to germinate were investigated and it was observed that either the rotting of the embryo or the death of the same soon after its initiation of sprouting or the total absence of the embryo were the reasons. The influence of hybrid inviability on these factors due to the disharmoneous genetic complex of the male and female parents has been discussed. Earlier germinated nuts were found to produce significantly more vigorous seedlings than the late germinated ones.

12. Response of *Corchorus Capsularis* to single or split application of N-fertilizer under light soil condition of Nilganj, Barrackpore.

B. K. DAS and D. B. DUA, Barrackpore.

To study the effect of single or split applications of N-fertilizer at sowing or at various stages of crop growth on the yield of jute fibre (*Corchorus capsularis*) an experiment in a split plot design was carried out in 1956-57 season at Nilganj in the light soils of average fertility. The treatments included application of 40 lb. N from 5 different sources viz. (1) ammonium sulphate, (2) ammonium chloride, (3) urea, (4) ammonium sulphate nitrate and (5) chilean nitrate applied in one, two or three equal instalments at the time of sowing, at 3 weeks crop age, at 6 weeks crop age and in their various combinations, thus giving 7 treatments in the subplots and 5 in the whole plots.

The response of jute to different sources of N-fertilizer was practically same and was not statistically significant, although ammonium sulphate gave the highest mean yield (24·85 mds. per acre) closely followed by ammonium chloride (23·32 mds. per acre), urea (22·91 mds. per acre), ammonium sulphate nitrate (22·15 mds. per acre) and chilean nitrate (20·92 mds. per acre).

Amongst various applications, split applications i.e. ⅓rd. at sowing time, ⅓rd. at 3 weeks crop age and remaining ⅓rd. at 6 weeks crop age gave the highest mean yield (24·98 mds. per acre) proving significantly superior to single applications either at sowing time (21·83 mds. per acre) or at 3 weeks crops age (20·65 mds. per acre) or even two applications—half at sowing time and remaining half at 3 weeks crop age (22·06 mds. per acre). Next to application in 3 instalments, application in 2 instalments i.e. half the quantity at 3 weeks crop age and remaining half at 6 weeks crop age or half at sowing time and remaining half at 6 weeks crop age or even single application at 6 weeks crop age also tended to give better results than those done at the time of sowing and/or at early stage of crop growth. In other words, there was a general tendency for higher response in both single or split applications when one of the applications were done at 6 weeks crop age.

13. Effect of fertilizers on the yield of Jute seed.

B. K. DAS and B. C. KUNDU, Barrackpore.

Effect of fertilizers with or without lime on the yield of jute seed was studied separately with *Corchorus capsularis* (Variety JRC-212) and *C. olitorius* (Variety-JRO-632) in split-plot design layouts during 1956-57 in the heavy clay soil (pH-5·9) of the Central Nucleus Jute Seed Farm at Panagarh. Ammonium Sulphate, single superphosphate and muriate of potash were included to supply 30 lb. N, 40 lb. P_2O_5 and 40 lb. K_2O respectively. Lime was applied at 3 md. per acre. As per schedule, application of lime could not be done earlier and was applied practically at the same time with that of superphosphate and muriate of potash during final land preparation. The treatments were lime or no lime in whole plots and the application of fertilizers singly and in various combinations in the sub-plots. Ammonium sulphate was applied as top dressing to 1 month crop.

From the data no significant responses were observed with lime, in both *C. capsularis* and *C. olitorius*. In *C. capsularis* the effect of N, P and N×P were significant at 1% level and N×K at 5% level. Highest yield of seed was obtained from the treatment NPK (6·70 mds./acre) closely followed by the treatment NP (6·66 mds./acre) as against 3·65 mds./acre of the control. In *C. olitorius*, the effect of N & P each were significant at 1% level & N×P at 5% level. The treatment NP gave the higest mean yield (4·17 mds./acre) closely followed by the treatment NPK (4·60 md/acre) as against 1·79 md/acre of the control.

14. Variety-cum-manurial studies on jute with reference to seed yield.

B. K. DAS and B. C. KUNDU, Barrackpore.

Response of 4 varieties of jute on yield of seed in both *C. capsularis* and *C. olitorius* at 2 levels of manuring (M_0 and M_1) were studied separately during 1956-57 season at Panagarh. The trials were conducted in split plot design layouts with fertilizers (M_0 and M_1) in the whole plots and the varieties in the subplots. The fertilizer dose (M_1) was 30 lb. N., 40 lb. P_2 O_5 and 40 lb. K_2O. N was applied as top dressing and P and K as basal dressing during the final preparation of the land. The varieties compared were (1) JRC-212, (2) JRC-321, (3) D-154 and (4) Fanduk for *C. capsularis* and (1) JRO-632, (2) JRO-753, (3) JRO-620 and (4) C.G. for *C. olitorius*.

In *C. capsularis* the effect of the varieties when manured was not significant, but without manuring the variety D-154 yielded significantly higher than the rest 3 varieties which fall in the same critical group at 1% level. The effect of fertilizer alone and the interaction (variety×fertilizer) were both significant at 1% level. Highest yield of seed was obtained from D-154 (4·74 mds. per acre) followed by JRC-212 (3·23 md. per acre) when no fertilizer was applied. With fertilizer Fanduk gave the highest yield (6·14 md. per acre) closely followed by JRC-312 (6·11 mds. per acre) and D-154 (5·51 mds. per cre). The percent increases on the yield of seed due to fertilizer application was much more in Fanduk (115·44%) followed by JRC-212 (89·16%) as compared to D-154 (16·24%).

In *C. olitorius*, unlike *C. capsularis* the effect of the varieties when unmanured was not significant, but when manured the varieties JRO-753 and JRO-632 were in the same critical group and yielded significantly higher than C.G. and JRO-620. The effect of fertilizer alone and interaction (variety×fertilizer) were also significant at 1% level. Yield of different varieties were practically same when no fertilizer was applied. With the application of fertilizer the variety JRO-753 gave the highest yield (3·89 mds. per acre) closely followed by JRO-632 (3·84 mds. per acre) as against C.G. (2·71 mds. per acre) and JRO-620 (2·42 mds. per acre). The per cent increase on the yield of seed due to the application of fertilizer was much more in JRO-632 (186·57%) followed by C.G. (165·69% and JRO-753 (130·18%) as against JRO-620 (79·26%).

15. Effect of date of sowing and stage of harvest on the yield of fibre of different jute varieties.

B. K. DAS and S. PALCHOUDHURI, Barrackpore.

To study the effect of different dates of sowing and stages of harvest in different varieties of jute and their interactions, two trials—one with *Corchorus capsularis* and the other with *C. olitorius* were conducted in 1956-57 in split-cum-strip design layouts at the Jute Agricultural Research Institute Farm at Nilganj, Barrackpore, West Bengal. The treatments included 2 capsularis varieties (JRC-321 & JRC-212) and 2 olitorius varieties (C.G. & JRO-632), six dates of sowing (21st March, 5th and 20th April, 5th and 20th May and 4th June) and 4 stages of harvest (100 days, 120 days, 140 days crop age and small pod stage of harvest). The two varieties were arranged in 2 main plots, and the dates of sowing and stages of harvest in strips perpendicular to each other.

In *C. capsularis,* there was no significant difference between the varieties although the late variety JRC-212 tended to give higher yield. The main effect due to "date of sowing" and "stage of harvest" and their combined effect i.e. the 1st order of interaction between sowing date and stage of harvest were each significant at 1% level. The other effects were not significant. Amongst dates of sowing, 20th April sowing gave the highest mean yield (20·69 mds. per acre), closely followed by 5th April (19·80 mds. per acre) and 21st March (18.61 mds. per acre) sowings, all being in the same critical group. The above three sowings were found to be significantly superior to other sowings. Amongst stages of harvest, small pod stage of harvest gave the highest mean yield (16·13 mds. per acre) followed by harvest at 140 days crop age (14·04 mds. per acre) and 120 days crop age (12 80 mds. per acre). All of them were in the highest critical group, each being significantly superior to the harvest at 100 days crop age.

In *C. olitorius,* JRO-632 was significantly superior (at 5% level) to C.G. The main effect due to "date of sowing" and "stage of harvest" and the interactions—date of sowing x stage of harvest and variety x date of sowing were all significant at 1% level. Amongst dates of sowing, 20th April sowing gave the highest mean yield (27·80 Mds. per acre) being significantly superior to all other sowings followed by 5th April sowing (24·35 mds. per acre) which again was significantly superior to March, May or June sowings. Amongst stages of harvest, 140 days crop age harvest gave the highest mean yield (18·12 mds. per acre) and was in the same critical group with harvest at small pod stage (16·86 mds. per acre) but was significantly superior to harvests at 120 or 100 days crop age.

16. Time of thinning out the excess plants on the yield of fibre in line sown jute (*Corchorus olitorius*).

B. K. DAS and S. PALCHOUDHURI, Barrackpore.

Jute seeds are sown much excess in number and after germination the plants are thinned out during the growth period. This operation is done 2 to 3 times in a broadcast crop where thinning is always associated with hand weeding. In a line sown crop about half the quantity of seed required for broadcast plots is sown. Even then it is much in excess for various reasons and requires thinning to the requisite spacing. In line crops, unlike broadcast sown jute, mulching and weeding with a wheel hoe can be arranged quite early at any time as it requires much less labour. Thinning of the plants in a line crop are therefore sometimes delayed to a convinient date. The preliminary study undertaken was to find out the best time of thinning out the excess plants and also to see how long this can be delayed profitably in a line sown jute. The trial was carried out in a replicated randomized layout in the Jute Agricultural Research Institute Farm at Nilganj in 1956-57 with *Corchorus olitorius* (Var. JRO-632).

There were 8 treatments each receiving one thinning and 7 wheel hoeings at an interval of one week beginning from 1st weekend to the 8th weekend of the crop age. Thinning was accompanied by hand weeding for all the treatments. Thus eight operations were given on eight weekends to each of the treatments, the variable factor was the thinning operation, which in the first treatment was given at 1st weekend, in the second treatment at 2nd weekend and so on and the wheel hoeings were adjusted in 7 other weekends.

From the results it was found that the treatment differences were significant at 1% level. Highest yield was obtained when thinning was done at 3rd, weekend. This was closely followed by the treatments receiving the same operation at 2nd and 1st weekends all three treatments proving significantly superior to treatments receiving thinnings either at 7th or 8th weekends.

17. Preliminary studies on the date of transplanting of 'aman' paddy under Nilganj, Barrackpore (West Bengal) conditions.

B. K. DAS and S. PALCHOUDHURI, Barrackpore.

Although much work has been done on paddy, detailed findings under different soil and climatic conditions are yet lacking. The present study was, therefore, undertaken to find out the suitable period of transplanting 'aman' paddy under Nilganj mid-land conditions with an ultimate aim to fit in paddy conveniently as a second crop in the double cropping programme with jute and paddy. Nine dates of transplanting paddy beginning from 1st July and ending on 19th September at intervals of 10 days were included. The trial was conducted in a randomized block layout during 1956 under Nilganj mid-land conditions. The variety of paddy used was Patnai-23.

Seedlings were raised on raised beds of 25'×4' sizes each receiving 60 lbs. cowdung, 1 lb. ammonium sulphate, 1 lb. superphosphate and ½ lb. muriate of potash. At 4 weeks age the seedlings were transplanted at regular spacings in the field which was manured generously with 200 mds. cowdung, 120 lb. superphosphate and 50 lb. ammonium sulphate per acre at the time of land preparation. One month after transplanting another dose of 50 lb. ammonium sulphate per acre was applied as top dressing. Weeding was given twice with a Japanese paddy weeder. The first weeding operation was given shortly after top dressing and the next one 20 days thereafter. Transplantings done on 9th and 19th September received only one weeding and second one could not be given as plants were in flower by that time.

From the results 10th August transplanting was found to have given the highest yield of paddy. Transplanting done either earlier to or later than 10th August gave lesser yields. The yield recorded from 1st July transplanting was 28·73 mds./acre. There was a gradual increase in yield as the time of transplanting was delayed and it was maximum on 10th August aftfer which the yield declined and was lowest on 19th September. Transplantings done between 1st July and 9th September came in the same critical group and proved significantly superior only to 19th September transplanting during the season under study.

As regards straw the highest yield recorded was from 1st July transplanting (97·37 mds./acre). There was a steady and gradual fall in straw yield with corresponding delay in the dates of transplanting, the lowest being from 19th September (28·79 mds./acre) transplanting.

18. Preliminary observations on the effect of D.D.T. applied to soil, on the fibre yield of Jute—*Corchorus olitorius*.

N. DUTT, D. K. DUTT and B. D. BHATTACHARJEE, Barrackpore.

A field trial was conducted in a randomised block layout with four replications to find out the effect of D.D.T. applied to soil, on the fibre of jute—*Corchorus olitorius*. There were eight different treatments including control where different dosages of D.D.T. (50% W.P.) were applied plotwise (1/145 acre approx.) during presowing operation. Taking the weight of an acre of soil, upto a depth of 6", as 2 million lbs. concentration of active ingredient came to 1·25 p.p.m.; 2·5 p.p.m.; 8 p.p.m. ; 10 p.p.m. ; 20 p.p.m. ; 40 p.p.m. ; 80 p.p.m. and 0 p.p.m. (Control). Seeds were sown broadcast and operations like thinning, weeding etc. were given as usual. The crop was harvested at the usual small pod stage after elimination of 1' ft. border all round and fibre extracted, dried and weighted plotwise.

No significant difference was obtained between the fibre yield of treated plots and control. Neither was there any significant difference between the green weight of the harvested crop nor between the number of plant population per treatment, indicating thereby, tolerance of the crop to the insecticide. Further work is in progress.

19. Investigations on silage making:—Digestibility and nutritive value of green Guar and wheat bhoosa silage.

N. D. KEHAR and P. N. JOHRI, Izatnagar.

In an attempt to conserve green fodders along with coarse fodders it was considered desirable to study if green guar and wheat bhoosa would make a suitable silage. One hundred and twenty nine lb. of green guar and twenty seven lb. of wheat bhoosa was uniformly mixed and were ensiled by the usual procedure adopted in these laboratories. The silage prepared had a characteristic sweet odour and greenish brown appearance. The silage on analysis was found to contain 8·13% crude protein, 1·35% ether extract, 34·20% crude fibre, 41·12% nitrogen-free-extract, 0·569% calcium and 0·15% phosphorus.

In order to study the palatability and nutritive value of the silage, a metabolic trial was conducted on six kumauni bullocks of an average body weight of 283 lb. The ensiled material was relished by the animals and the consumption, per 100 lb. body weight, was 755 gm. The average digestibility coefficients for crude protein, ether extract, crude fibre and nitrogen-free-extract were found to be 51, 38, 50 and 41 respectively.

The digestible crude protein, total digestible nutrients and starch equivalent, were found to be 4·14 lb., 68·28 lb. and 32·5 lb. respectively.

All the animals were in positive balance with respect to calcium, phosphorus and nitrogen. They maintained a general healthy condition during the feeding regime and reflected, on an average an increase of nine lb. in live weight during the period of observation.

20. New lines of field experimentation in crop plants in progress at the Orissa State Agricultural Research Stations.

B. MISRO, Bhubaneswar.

Three new lines of field experimentation in crop plants have been indicated. (a) In plants like *Trichosanthes dioica* and *Momordica cochinchinensis*, the flowers are dioecious. The plants bear exclusively male or female flowers. The number of male plants in a unit area of the crop would determine the yield. Hence it is important to estimate the optimum percentage of male plants conducive to maximum production.

(b) In vegetatively propagated crops it is not unusual to find the individual plants flowering and seeding, the time lag between the first and last flowering plants being as much as sixty days or more. Such a variation is genetic in origin. Flowering groups, the individuals within each of which flower in ten days of one another, could be made and the yield compared between different flowering groups. Work on this line is in progress in turmeric and sweet potato.

(c) Seedling with one, three or four cotyledons in nurseries of dicotyledonous plants are not uncommon. With the change in cotyledon number is associated the change in phyllotaxy of the main axis and some physiological change in cotyledon number in the seedling can be taken as an index of development in the plant- to- be and thus one can pitch upon useful variations which can be exploited.

21. Grass farming with sewage water in Madras.

C. RAJASEKHARA MUDALIAR, Madras.

The paper deals with the cultivation of grasses in Madras State in general and Madras City in particular, with sewage irrigation. In the introduction, the origin and development of 'grass farming' in the world, in several important cities of India, and in Madras State is referred to. The performance of different grass species in Madras State and in the newly-started 'Sewage Farm' near Madras City, by the Corporation of Madras, is dealt with in detail. The behaviour of the two important grass species in this new farm, namely, *Panicum barbinode* (Water grass) and *Panicum maximum* under the soil conditions prevailing in the farm is described.

The establishment and growth of *Panicum barbinode,* was observed to be the best in heave clayey soils, while guinea grass (P. maximum) failed even to establish under these conditions. *P. barbinode* withstood water-logged conditions and poor drainage facilities existing at present in this farm, while *P. maximum* proved a failure.

22. Trials for improving the germination quality of Sugarcane.

K. L. MUKHERJEE, Deoria.

Sugarcane is grown asexually from the nodal buds by cutting the mother stalk into sets. Germination of these buds is governed by genetic and physiologic factors —both external and internal. Dormancy is generally absent in them and they can grow on the living stalk itself if 'apical dominance' is removed or will germinate immediately under proper environmental conditions. Selection of good quality sets at the time of sowing avoids the use of excess planting material and ensures uniform growth with high final yield.

On the basis of the local survey in the zones of Baitalpur and Deoria Sugar Mills (Eastern U.P.) and laboratory trials (conducted in the College of Agriculture, Deoria), suggestions are being given for sowing disease-free, healthy and well nourished sets from genuine, improved varieties from the middle portion of the stem. Wherever possible "rehungan system" can be followed. Presowing treatments like hot water, cold water and lime water have several advantages. Pretreatment with sugars, nutrient solution and growth substances are of little use, although their long term effects on the after growth have not been worked out. Some local practices (partial drying and water dipping, have been duplicated and their merits discussed. Physiological interpretations for these observations have been tendered.

23. Safflower seed and oil : Part 1. Production in India.

N. BHOJ RAJ NAIDU, Hyderabad (Deccan).

Safflower seeds are grown over an acreage of about 14-15 lakh acres in Bombay, Hyderabad, Bihar, Madhya Pradesh and Andhra (Rayalaseema). The area and production of safflower seed in the former Hyderabad State was 8·1 lakh acres and 89 thousand tons respectively (1954-55). By the recent trifurcation of this state, safflower acreages going to Bombay, Karnatak and Andhra Pradesh are above 4·8, 2·5, 0·8 lakh acres or about 60, 23 and 6 thousand tons respectively making a total of about 10·0, 3·0 and 1·1 lakh acres under safflower. Expanding safflower cultivation in India is desirable, as also work on high oil and dye yields by plant breeding, to improve the low oilseed yields per acre in India (250-350 lbs. as against 400-4,000 lbs. in advanced countries). Previous genetic work, morphological character of the seed, and control measures for fighting crop pests, are reviewed (24 references).

24. A study on fodders of Hissar district in Punjab.

B. M. PATEL, B. G. SHAH and V. V. MISTRY, Anand.

Changes in the composition of guar (*Cyamopsis psoraliorides*), jowar (*Andropogon sorghum*), bajri (*Pennysetum typhoideum*), wheat, barley, oat, berseem, lucerne and pasture grasses at different stages of growth have been studied. In guar, jowar and bajri fodder there is a decreasing trend in protein, ether extract and calcium, while crude fibre and N.F.E. increase with maturity. Phosphorus content tends to decrease. Similar trend of variation is found in wheat, barley and oat fodders. In lucerne and berseen there is a significant decline in crude protein and increase in crude fibre from the first monthly cut to the subsequent cuttings. Ether extract tends to increase while phosphorus reveals a decreasing trend. Generally samples of the same fodder from different villages do not vary significantly.

Wheat chaff from Hissar area is superior to wheat straw from Anand area while gram bhusa (outer pod-coverings, thin stems and leaves), though a legume by-product, is poor in crude protein (3·94%) but rich in calcium (1·40%) and it is liable to a wide variation in composition.

Among the grasses growing in the area ghamur (*Panicum antidotale*) is the best. Crude protein and ether extract decrease in the grasses as they mature.

Babul (*Acacia arabica*), neem (*Melia azadirachta*) and shisham (*Dalbergia sissoo*) leaves are rich in crude protein (7 to 16%) and calcium (1 to 2%) and can serve as good supplementary fodder.

25. Effect of harvesting pasture in Kutch at different intervals on its yield.

B. M. PATEL, B. G. SHAH and P. S. PATEL, Anand.

The effect of harvesting at different intervals on the yield of pasture in Banni area of Kutch has been studied by laying 32 enclosures at random in the whole area. It is found that the maximum yield of 5,595 lb. per acre which is 45 per cent higher is obtained by harvesting at monthly intervals. When the first cut is taken after two months followed by aftermath harvest after one month, the yield does not differ significantly from that obtained by harvesting only once at three months' growth although the former tends to be higher.

The yield of grass not only varies from village to village but also from enclosure to enclosure around the same village. This may be attributed to the different varieties growing and to lack of proper management.

The results suggest that harvesting the pasture grasses or rotational grazing at monthly intervals would be advantageous.

The study of the qualitative changes in the pasture with maturity is in progress,

26. The digestibility and nutritive value of common roughages of Gujarat. I. Straws.

B. M. PATEL, B. G. SHAH, P. S. PATEL and P. C. SHUKLA, Anand.

A study has been made of the chemical composition, digestibility and total digestible nutrient (TUN) contents of six common straws fed to cattle in Gujarat. The straws under investigation are Bavto (*Elusine coracana*), Kodra (*Paspalum scrobiculatum*), Wheat (*Triticum sativum*) Paddy (*Oryza sativa*), Bajri (*Pennisetum typhoideum*) and Jowar (*Andropogon sorghum*). Digestion trials were conducted on six adult bullocks of Kankrej breed for each of the straws. All collection periods were ten days in length. Digestion coefficients and digestible nutrients for all the straws are presented.

The digestible protein contents (per 100 lbs. of dry matter) of straws under study are as given below:

Bavto 0·50, Wheat 0·18, Jowar 1·17, Paddy 0·30, Bajri 0·93, Kodra straw gave negative balance for protein.

The TDN contents of straws studied are as follows:

Bavto 60·74, Wheat 56·85, Jowar 55·30, Paddy 54·38, Bajri 51·06 and Kodra 50·54.

On the whole Jowar, Kadbi is superior in nutritive value to the other straws studied.

27. The digestibility and nutritive value of common roughages of Gujarat. II. Green Fodders.

B. M. PATEL, P. C. SHUKLA and V. V. MISTRY, Anand.

A study of the chemical composition, digestibility, and total digestible nutrient (TDN) contents of six common green fodders and Jowar silage has been made. The fodders tested were: Lucerne (*Medicago sativa*), Berseem (*Trifolium alexandrinum*), Oat (*Avena sativa*), Guinea grass (*Panicum maximum*), Maize (*Zea mays*), Jowar (*Andropogon sorghum*). Each digestibility trial was conducted on six adult bullocks of the Kankrej breed. All collection periods were ten days in length. Digestible coefficients and digestible nutrients for all the fodders are presented.

The digestible protein contents (per 100 lbs. of dry matter) of the fodders under study were as follows: Lucerne 19·34, Berseem 8·46, Oat 3·23, Jowar 3·80, Maize 2·61, Guinea grass 3·80 and Jowar silage 0 68.

The TDN contents of the roughages studied were as follows:

Lucerne 69·71, Berseem 60·07, Oats 66·84, Jowar 66·58, Maize 63·77, Guinea grass 50·73 and Jowar silage 47·15.

Crude protein in Lucerne and Berseem, is better digested than that in non-legumes. Berseem and Lucerne provide highest amounts of TDN. Total digestible nutrients for Jowar silage and Guinea grass are appreciably lower than for other fodders. Jowar straw is better digested than Jowar silage, but green Jowar is definitely superior to both. Oats provide more TDN than Guinea grass.

The calcium, Phosphorous and nitrogen balances are also given.

28. Analytical and microbiological aspects of Pepper* (*Piper Nigrum* I.).

T. N. R. RAO and D. S. JOHAR, Mysore.

Pepper is widely used as a flavouring agent in food industry and as carminative with alleviative qualities in medicine. Data is presented to show the comparative values of Indian and foreign pepper. The microbes responsible for spoilage in food industry have been isolated and control measures indicated to eliminate them.

Similarly, mouldy pepper has been reclaimed by suitable treatment. Effects of pepper on intestinal flora are under progress.

29. Study of response of rice to different levels of Farm Yard Manure and Inorganic Fertilisers.

B. N. SAHU and I. C. MAHAPATRA, Bhubaneswar.

For getting information on the relative value of organic manure, nitrogenous and phosphatic fertilisers in the form of Farm Yard Manure, Ammonium Sulphate and Superphosphate respectively, alone and in combinations, on the yield of rice a field experiment was laid down in the Agronomy Section of State Agricultural Research Station, Bhubaneswar, Orissa for two seasons. This experiment was laid down in a 3^3 confounded factorial design with 3 levels of N (O, 20 and 40 lbs. per acre) × 3 levels of Phosphorus (O, 20 and 40 lbs. per acre) × 3 levels of Farm Yard manure (O, 100 and 200 mds. per acre) in 3 Blocks of nine plots each in two different comparable sites. The paper presents the results obtained during the seasons 1955-56 and 1956-57.

The results indicate that with the increase in the level of F.Y.M. there is increase in the yield of grain. The grain yield has been largely influenced by the application of nitrogen. But efficiency of utilization of nitrogenous fertiliser by rice decreases with the increasing dose of application. Phosphorus alone has no response but in combination with Farm Yard Manure it has shown a positive and significant interaction. There is a tendency of interaction between Farm Yard Manure and nitrogen.

The yield data also reveal that farm yard manure is about 89·73% efficient in comparison with Sulphate of Ammonia. Under Bhubaneswar condition application of either 200 mds. of Farm Yard Manure or 40 lbs. N in the form of Ammonium Sulphate singly is considered optimum. A combination of 100 mds. of Farm Yard Manure, 20 lbs. N and 20 lbs. P_2O_5 can safely be applied for getting higher yield.

30. Effect of increasing levels of Phosphatic Fertilizers on the growth and yield of Gram.

NIRAD K. SEN and MANAS K. JANA, Kharagpur.

Effects of increasing doses of superphosphate from 20-120 lbs. P_2O_5 per acre on gram in acidic (pH 5·8) lateritic sandy loam soil was studied. The growth and yield increased proportionately with the increasing doses of superphosphate upto 60 lbs. P_2O_5 per acre beyond which increase was progressively less. It was also observed that the rate of increase in yield per pound of P_2O_5 per acre steadily decreases beyond 20 lbs. of P_2O_5 per acre. It seems that the economical dose of superphosphate for gram will be between 30-40 lbs. per acre, in this region.

Increasing doses of superphosphate stimulated vegetative growth as measured by, height of the plant, number of branches and seed setting, and seed size but not the time of flowering and maturity.

31. Effect of phosphorus on growth, yield and oil-content of mustard (*Brassica juncea* Hook f. and Thoms).

P. K. SEN and A. K. SARKAR, Calcutta.

Results of an experiment on the effects of varying levels of phosphorus on growth and yield of *Brassica Juncea* Hook. f. & Thoms. Var. Rai P-85 conducted in sand culture using the Richards' nutrient solution, are presented. Taking the amount of phosphorus in the standard full nutrient solution as IP, the level of phosphorus was on the one hand varied in four increasingly higher doses viz., 1·5P, 2P, 2·5P and 3P, and on the other hand it was reduced in four increasingly lower doses viz., 1/3 P, 1/9 P, 1/81 P and OP. The ionic deficits in the respective phosphorus deficiency treatments, due to the reduction in the amounts of Na_2, HPO_4, 12 H_2O, were made good by the addition of proportionate amounts of $Na_2 SO_4$, $10H_2O$ in order to maintain the pH of the nutrient solution between 6·5 and 7·0.

Increase in phosphorus has shown an acceleration in the rate of growth and hastening of maturity. It has also increased total dry matter, and particularly the relative proportion of root growth. Phosphorus also indicates an optimum effect on yield of seed and oil content.

The phosphorus deficiency treatments have not shown their characteristic effects. The adverse effects of phosphorus deficiencies seem to have been compensated by the additional supplies of sulphur.

Sulphur appears to play an important part in growth and metabolism of the plant. Further studies with a view to elucidate the specific effects of this element on *Brassica* sp. and its interaction with N, P and K is considered necessary.

32. Studies in the manuring of Groundnuts in Bihar.

M. P. SINGH, Sabour.

The manurial experiments on groundnuts at Sabour, in South Bihar in clay loam soil with the manurial status in terms of N, available P and K as 0·05, 0·0076 and 0064% respectively on air oven dry basis with pH 7·0, have been dealt with. The results of these experiments which have been conducted for a period of four years from 1953-56 show that the groundnut pod yields are materially enhanced by the application of phosphate as P_2O_5 applied basically at the rate of 60 lbs. an acre. The effect of potash, also applied basically as K_2O at the rate of 30 and 60 lbs. an acre has been to depress the yield of groundnut pods, compared to plots where no potash had been applied. The application of phosphate at 60 lbs. an acre, which results in the higher yields of groundnut pods also has been found to result into a net profit of Rs. 15·08 per acre, after adjusting for the price of the fertilizer and the application charges.

The above experiments were conducted in 3^3 design with four replications. In 1953-54 the net plot size employed was 3′×18′ which was changed to a larger plot size of 10′×24′ in the subsequent years. The doses of fertilizers applied was 'N' as sulphate of ammonia at 0, 15 and 30 lbs.; 'P' as P_2O_5 at 0, 30 and 60 lbs. and potash as K_2O at 0, 30 and 60 lbs. an acre. The fertilizers were applied basically and worked into the soil with the help of forked spades before sowing of groundnuts, which was done in June on rains and harvested in November.

33. Chemical control of Hardy' Weeds : Trials with Weedicides.

V. RAVINDRANATH and SYED VAHEEDUDDIN, Hyderabad-Dn.

Experiments were conducted at Government Main Research and Experimental Farm, Rajendranagar with three weedicides viz. Fernoxone, Atlacide and Extar 'A' with different concentrations, in a bid to find out effective control of some hardy weeds. Extar 'A' proved to be highly effective. Four weeds. viz. *Tridax procumbens, Phaseolus trilobus, Chrozophora rottleri* and *Hibiscus vitifolius* were found to be most affected by Extar 'A'.

These weeds can effectively be controlled by Extar 'A' at the rate of 2 lbs. in 32 gallons of water.

34. Chemical Control of Weeds of Jowar Crop: Trials with Weedicides.

R. BENER RAJ, SYED VAHEEDUDDIN and D. BAP REDDY,
Hyderabad, Dn.

Experiments were conducted with six weedicides, viz., Fernoxone, 2, 4-D sodium salt, Atlacide, Hedenol, Cornox, and Extar 'A' with different concentrations, at Government Main Research and Experimental Farm, Rajendranagar, in order to find out suitable weedicides for the control of weeds of jower crop. The weedicides Fernoxone, Atlacide, and Cornox proved most effective in controlling the weeds of jowar crop.

Twenty four weeds belonging to 13 different families were collected from the jowar field and among them, nine weeds, viz., *Digeria arvensis, Sclerocarpus africanus, Lochneia pusilla, Trichodesma indica, Euphorbia ethymoides, Alysicarpus monilifer, Borreria hispeda, Laptademia reticulata* and *Desmodium gangeticum*, were found to be the most affected, the first three being severely affected by all the weedicides and all concentrations used. Seven weeds viz., *Crotalaria vericosa, Phyllanthus madraspatensis, Cocculus villosus, Indigofera glandulifera, Cardiosperum halicacabum, Phaseolus trilobus* and *Legasca mollis* proved tenacious and eight more weeds viz., *Echinocloa colona, Cyperus rotundus, Acacia arabica, Cyanotis axillaris, Crotalaria funcea, Digitaria marginata, Digitaria sanguinalis,* and *Acanthospermum hispidum* had almost no effect on them.

The affected weeds of the jowar crop could be controlled by Fernoxone and Atlacide at the rate of ½ oz. per gallon of water and Cornox at the rate of 90 c.c. per gallon of water.

The monocot weeds were not affected by Fernoxone, 2, 4-D Sodium salt, Hedenol and Cornox. However, Atlacide and Extar 'A' had a slight effect on them.

No appreciable difference was noticed in the effect between the plots treated with high and low volume nozzles but for a reduction of volume of spray to about ⅓ to ½.

PLANT BREEDING AND GENETICS

35. The breakdown of Microsporogenesis in Male Sterile Tabacum.

B. R. MURTY and N. R. BHAT, Rajahmundry.

Male sterile mutant have recently been reported in *N. tabacum* and two duplicate genes assumed for the production of the mutant character. The present investigation consisted of a detailed cytological study of the course of microsporogenesis in male sterile plants from the mutant line and segregates from crosses with diverse normal types to which the character had been transferred. Field observations were taken on the floral organs and capsules. Breakdown was observed at several stages of microsporogenesis starting from the differentiation of the tapetum itself, while megasporogenesis was inferentially normal. Male sterile plants having diverse genetic backgrounds were more or less similar in the breakdown of microsporogenesis.

From the above findings, it is inferred that (i) the two duplicate genes responsible for the mutant character are uninfluenced by their genotypic background; and (ii) they may be complementary in causing an effective breakdown in sporogenesis and may *even* be operating in successive stages. The absence so far of any report of the 'male sterility' character in the putative parents of *tabacum* might further support the inference that the two recessive genes are complementary in their operation.

SOIL SCIENCE AND SOIL CHEMISTRY

36. Studies on microbiology of the rhizosphere of *Corchorus otitorius*. I. The effect of age of the plant.

A. K. BANERJEE, A. B. ROY and M. K. MUKHERJEE, Barracpore.

The microbiology of rhizosphere of jute plants which has not hitherto been studied was worked out in some detail. The effect of age of the plant on the microflora inhabiting the root zone was studied in particular with special reference to fungi, *Azotobacter*, actinomycetes and bacteria under four different cultural conditions. It was observed that the ratio of number of microorganism in the rhizosphere and soil, immediately outside it, increased regularly in case of fungi and *Azotobacter* with the age of the plant. In case of bacteria and actinomycetes the ratio first registered a fall and then a rise.

The number of *Azotobacter* increased considerably in the plots cropped with jute in comparison to plots not cropped with jute. The total available nitrogen was also at higher level in plots with jute.

37. Role of Phosphates in the retention of Ammoniacal Nitrogen in soils.

S. C. CHAKRAVORTY, S. GHOSH, S. K. BASU
and M. K. MUKHERJEE, Barrackpore.

It has been found that with the application of superphosphate (particularly at a higher dose) with progressive increase in the amount of nitrogen added to the soil, more ammoniacal nitrogen is found after 2 months of crop growth. With nitrogen alone, this phenomenon is not so marked. Liming also has not shown any proportionate increase, in the amount of ammoniacal nitrogen with the increase in the quantity of added nitrogen. It is, therefore, considered that besides the plant's requirement for larger amounts of P with higher doses of N, this phenomenon accounts for the response of jute (especially *C. olitorius*) to higher doses of nitrogen with phosphate but not to nitrogen alone at a very high level as jute is a crop which responds more to ammoniacal nitrogen.

38. Influence of free Silica and Sesquioxides on the buffer properties of Soils.

A. K. DAS, Kharagpur.

Clay colloids separated from soil often contain appreciable amounts of free silica and oxides of iron and aluminium. Influence of these secondary minerals on the base-exchange and buffer properties of clay fractions separated from two soils viz. Pussa and Kolaba has been studied. Drosdoff's method of analysis revealed the presence of varying amounts of these oxides in the two clays examined. The residue which remained undissolved in Drosdoff's reagents showed considerable variations in base-holding capacities under different pH conditions, from their original values. It was concluded that free oxides, which are often abundant with Kaolinitic lateritic soils, play an active part in base-exchange and buffer properties of soils. Buffer curves of Bauxite and Limonite obtained from geological deposits in India supported this conclusion regarding their active role in base-exchange reactions of soils.

39. Physico-chemical properties of the Black Cotton soils of India and the factors responsible for their dark colour.

B. C. DEB, Poona.

The chemical composition of clay fractions of some black cotton soils from Surat, Coimbatore and Bellary districts shows that they have SiO_2/Al_2O_3, SiO_2/R_2O_3 ratios much above 2·0 and contain appreciable amount of non-exchangeable magnesium. These show that clays are of montmorillonite type. This is further confirmed from the electrometric titration and viscosity curves with addition of caustic soda. All the curves have the same characteristics as that of montmorillonite.

As regards factors responsible for dark colour, it has been found that when typical black cotton soils are treated with hydrogen peroxide, caustic soda and sodium pyrophosphate separately, though there is no appreciable change in colour by hydrogen peroxide or caustic soda treatment, the pyrophosphate treated soils are changed to pale brown to brown in colour. It thus shows that the colour of the black cotton soils is due to that part of organic matter, which persists even after hydrogen peroxide or caustic soda treatment but is dissolved by pyrophosphate.

40. Beneficial effects of Sodium Chloride added to the soil when associated with Manures and Fertilizers for crops production.

S. V. DESAI, Varanasi.

The accumulation of Sodium salts in Saline and Alkaline soils has produced an impression that addition of Sodium salts to soils is harmful. In reality the addition of Sodium salts have always produced increases in crop yields. When associated with fertilizers large amount of common salt have been used successfully to produce increases in crop yields. In U. K. during last war additions of 5 cwt. per acre were used in fertilizing Potatoes, Barley, Mangolds, Sugarbeet and other crops without any detrimental effects.

At I.A.R.I., New Delhi additional increases in yields were obtained with Sodium Chloride in pots receiving Ammonium Sulphate and other fertilizers. It is therefore necessary to modify the impression about Sodium salts and discard the Phobia against Sodium in fertilizers.

It is the lack of drainage that produces the salinity and alkalinity in the soil and not the accumulation of Sodium. Even the soils having very saline sea water at depth of 3 feet produce excellent crops in Netherlands. The prejudice against Sodium salts is unfounded and should be given up.

The amount of Sodium salts which gets added to the soils is very high where irrigation is practised. The saline water of wells in Kaira District, Bombay Presidency is prized for producing special high quality Tobacco used for chewing and other purposes. It is high time that the role of Sodium in soil fertility is properly evaluated and the beneficial effects produced by Sodium understood in proper perspective.

41. Amelioration of alkali soil by chemicals in combination with organic matter like weeds.

S. P. MITRA, Allahabad.

Experiments on the amelioration of alkali soils by sulphur, weeds, sulphur in combination with weeds, gypsum, and gypsum in combination with weeds show that with the lapse of time, their efficacies go on increasing which is due to the chemical reactions reaching completion. It is interesting to find that weeds, though not much effective in reclaiming alkali soil when used alone, prove of great value when used in combination with sulphur or gypsum.

42. Studies on the influence of different Algerian rock phosphates when reinforced with leguminous plant material like cow-pea *(Vigna sinensis)* on carbon transformations, exchangeable calcium and pH of alkali soil.

S. P. MITRA, Allahabad.

It has been observed that exchangeable calcium of alkali soil greatly increased when Algerian rock phosphates were added in conjunction with cow-pea (*Vigna sinensis*). This increase in exchangeable calcium has been ascribed to the dissolving action of carbonic and other weak acids liberated by the oxidation of organic matter on $CaCO_3$ of the alkali soil or $CaCO_3$ or CaO present in rock phosphates. In this way soluble Ca ions replace the Na ions from the exchange complex of the soil, thus, increasing the exchangeable calcium of the system. The carbon dioxide produced may also react with $Ca_3(PO_4)_2$ present in rock phosphate or calcium phosphate present in alkali soil forming more soluble dicalcium phosphate which introduces more calcium into the system.

In all cases the introduction of insoluble phosphates with organic matter helped in lowering the pH of the alkali soil. This is due to the fact that the dicalcium phosphate formed by the decomposition of organic matter on tricalcium phosphate when comes in contact with water, partially behaves as a dilute solution of monocalcium phosphate and reclaims alkali soils slowly.

43. Effect of different phosphates on nitrogen status of alkali soil when reinforced with cow-pea *(Vigna sinensis)* as organic matter.

S. P. MITRA, Allahabad.

The incorporation of various phosphates like basic slag, Trichinopoly rock phosphate, tricalcium phosphate, aluminium phosphate and five Algerian rock phosphates with cow-pea (*Vigna sinensis*) as an energy material greatly increased the carbon oxidation and nitrogen fixation processes when added to alkali soils.

44. Changes in the total cation exchange capacity in Dumat soil of Agra district by humifying the leguminous weeds (i) Wild Indigo *(Tephrosia purpurea)* and (ii) Jwasa *(Alhagi camelorum)*.

B. R. NAGAR and ABANI K. BHATTACHARYA, Agra.

Two leguminous weeds—1. Jwasa (*Alhagi camelorum*) and 2. Wild Indigo (*Tephrosia purpurea*) were humified (for 16 weeks) in the Dumat soil of Agra district and the changes in total cation exchange capacity, residual organic carbon, and pH were studied.

It has been suggested that total cation exchange capacity of the humified soil samples depend upon (1) residual organic carbon, (2) SiO_2/R_2O_3 ratio of the weed and (3) structure of clay minerals. An interesting correlation between the rise in pH and the increase in total cation exchange capacity has also been observed.

45. Carbon and Nitrogen status of arid and semi-arid region of India.

S. P. RAYCHAUDHURI and V. K. MUTATKAR, New Delhi.

From the study of the effect of climate and parent material on the nitrogen and carbon content of black and alluvial surface soil in the arid and semi-arid region of India (Punjab, Delhi, Rajputana and Saurashtra), the following general conclusion can be drawn :

1. Organic carbon and nitrogen in both black and alluvial soil in this region increase with rainfall and N.S.Q. and decreases with increase in temperature. In the case of black soil both nitrogen and carbon decreases after 40 inches of rainfall and 500 N.S.Q. The C/N ratio also shows decrease with increase in temperature in both soils.

2. Though carbon and nitrogen content in both groups of soil, black and alluvial, increases along with altitude, the relationship is not clear.

3. Regarding the effect of parent material in the same climatic area in the Delhi State following conclusion can be drawn :

> In Delhi soil recent alluvium (Khadar) shows the highest carbon and nitrogen percentages in comparison to old alluvium (Bangar). Next in order comes Kohi or hilly area and then Dabar or lowlying area which shows the least carbon and nitrogen percentages. In every group of soil in Delhi State there is a variation in carbon and nitrogen percentages which is purely due to differences in texture of soil.

4. Some theoretical values of nitrogen percentages has been calculated to examine the maximum extent to which organic matter can be built up in the soil. It will be noted that actual nitrogen in the cultivated soil generally varies from 14 to 25 per cent of the optimum values, the maximum being 45 per cent and minimum 6·95 per cent. The present values of carbon and nitrogen in the cultivated soil studied, are low and organic matter can be built up further, by suitable agronomic practices.

46. Availability of Molybdenum in Gujarat soils.

G. R. REDDY and B. V. MEHTA, Anand.

Available and total Mo contents of typical soils of Gujarat and Saurashtra have been determined. The leaves of cereal, leguminous, vegetable, fruit, grass and cash crops and ornamental plants have been analysed for Mo content. It is found that the soils of Gujarat and Saurashtra are neither high nor low in Mo to produce any deficiency diseases in plants or toxicity to cattle. Plants vary widely in their capacities to absorb Mo from soil. Legumes tend to absorb more Mo than do non-legumes. This is not always so as there are some non-legumes which contained more Mo than legumes. Mo content of leaves of various kinds of plants increase with the age of the plant. Older leaves contained more Mo than younger ones. The minimum number of crops our soils can bear would be 130 and maximum 1,030.

46A. Weathering of basaltic minerals under varying rainfall conditions.

V. N. SANT and R. V. TAMHANE, New Delhi.

The Deccan basalts which are extra-ordinarily uniform in composition in greater part of Bombay state were selected for the study of the differences in their weathering tendencies under high and low rainfall conditions. Seven soil profiles developd on basaltic rock, three from high rainfall region (rainfall 170″—129″) and four from low rainfall region (rainfall 41″—18″) were selected for this study.

Well marked differences in the decay and weathering of the various mineral constituents of the basalt are observed at different horizons in the soil profiles. Under high rainfall conditions the intensity of weathering of the weatherable minerals like pyroxenes and plagioclase felspars show a very well marked decrease down the profile. Secondary minerals like limonite and quartz formed by weathering also show significant changes. Limonite which occurs in high proportion at surface horizons decreases sharply at lower horizons. Whereas secondary quartz shows a reverse trend. The limonite imparts a reddish colour to soils formed under such conditions.

Under low rainfall conditions, however, the intensity of weathering of the various minerals shows a steady decrease down the profile. Secondary quartz increases steadily with depth, while the proportion of limonite is insignificant.

The mineralogical and other studies of the various soil profiles and parent rock show not only the differential weathering of the minerals present in a basaltic rock, under varying rainfall condition, but also reveals that they have given rise to different types of soils possessing characteristic properties.

47. Activated Sodium Silicate helps removal of silt from Hooghly River water.

R. K. SEN, Barrackpore.

It has been observed that activated sodium silicate, when used along with alum, gives considerable aid to coagulate silt in the treatment of the Hooghly river water. It shortens the time to form floc, increases its size, toughness and density, permitted more rapid settling, produce a clear settled water. It can produce good results over a wider pH-range. A comparative study have been made by using Alum, Sodium Aluminate and Activated Sodium Silicate from the point of view of overall economy in the cost of treatment.

48. Seasonal Variations in the Properties of Ganges Silt.

R. K. SEN, Palta and B. CHATTERJEE, Sibpur.

In continuation of the work on the properties of Ganges silt, studies have been made of the variations in pH on the gradual addition of alkali to hydrogen clays (H-clays) prepared from Ganges silt collected at Palta (Barrackpore, Calcutta), month by month, during three consecutive years. The pH-alkali concentration curves of H-clays prepared from silt samples collected during the months July to November show only one inflexion at about pH 7·0. The total acidity calculated at the inflexion point has been found to be highest for the H-clay prepared from the November silt and decrease in the order : November>October>September >August> July. The potentiometric titration curves of H-clays prepared from silt samples collected during February to June show two inflexion point, one at about pH 5·0 and the other at about pH 7·0. The ratio of the total acidity of these H-clays at the second inflexion point to that at the corresponding first inflexion point is about 2·0. These results in conjunction with the data on chemical composition of these H-clays (Sci. & Cult., *21*, 620, 1956) suggest the presence of Kaolinite, montmosillonite and illite in Ganges silt and the predominance of Kaolinite in silt samples collected during February to June and the relative abundance of montmorillonite and illite in those collected during July to November.

49. Soil Conservation Survey and Land use planning for Darjeeling Hills.

K. SENGUPTA and T. SENGUPTA, Calcutta.

A soil conservation survey of the tributaries of Teesta viz., Lish, Gheesh, Chel, Neora and Relli which have their origin in Darjeeling district was undertaken for determining the present state of affairs and for land use planning. The following factors were given careful consideration to work out a satisfactory land use planning :—

(a) Physical factors—which includes (i) Soil, (ii) Degree of erosion, (iii) Slope & (iv) climate,
(b) Farming history and
(c) Social and Economic condition.

The 'soil of the area is derived from (i) Gneiss, (ii) Schists, (iii) Phyllites & states, (iv) Quartzites & Sandstones. The depth of soil varied from less than 9 inches to above 3 feet. In some places more than 75% of top soil was eroded.

Land having slope less than 20% was negligible. More than 50% cultivation is done on slopes exceeding 40%.

The annual rainfall varies from 100 to 300 inches most of which occurs within the months of Mar. to October.

At present Maize, Millet, Buck wheat, Aman paddy and Cardamom are being cultivated. Aman paddy is cultivated in bench terraced fields and Cardamom on the sides of the Jhoras. The rest of the crops are cultivated in steep slope with up and down ploughing.

The pressure on land is very heavy in the Darjeeling hills, and it will not be possible to settle the cultivators elsewhere in the hills or in plains as they cannot stand the climate of the plains.

Taking into consideration the above mentioned factors land capability classification was done. Under Darjeeling condition six land capability classes will be applicable,

50. Some physical properties and moisture relation of the Laterite soil of Kharagpur.

T. K. SUBRAMANYAM, Kharagpur.

The laterite soil of the Agricultural Engineering farm, Indian Institute of Technology, Kharagpur, was examined for Mechanical Composition, Volume weight, pore, space, water holding capacity and soil moisture relationship.

For studying the soil moisture relationship the soil was placed in a metallic container with perforated bottom. A tensiometer was fixed in the soil. The soil moisture tension was directly read in the vacuum gauge of the tensiometer and the moisture content at the corresponding tension by oven drying.

The results show that the soil falls under the classification of heavy sandy loam. The bulk density is fairly high with a corresponding lowering of pore space probably due to the paucity of organic matter. Both the upper and lower plastic limits are not high indicating the absence of excessively fine grained or plate like minerals.

The moisture contents at 3·8 cms of mercury or 50 cms of water tension corresponding to field capacity and wilting point are found to be 22·5% and 8% respectively. The readily available water at which maximum growth of cultivated crops is sustained and which tends to lie between 5 and 30 cms. of mercury tension is 10% or 1·6" per foot depth.

51. Further study of the soils of Rayadaga, Orissa.

G. RAMCHANDER and T. SURYANARAYANA, Guntur.

Soil Survey is being recognised as having an important place in agricultural Planning in order to utilise the results for better cropping.

A Study of the fertility status of the Soils of Rayagada in Koraput District of Orissa are reported. The Soil survey was mostly of lands where sugarcane is grown.

According to Mukherjee's classification (5), the Soils could be classified as sandy of the Sub-Type 'X'.

For cultivation of cane with an eye on yield and quality, a soil reaction of around 6·5 is advantageous. At lower pH the availability of Phosphates and Potash are affected. Canes deficient in these accumulate Nitrogen and other Mineral constituents and thus its quality suffers.

The following may be taken as a rough guide specially for Sugarcane growth according to the type of Soil available.

		Available	
	N%	P_2O_5	K_2O
Sandy	0·150	0·050	0·180
Sandy 10 am.	0·100	0 060	0·130
Silty 10 am.	0·080	0·070	0·080
Clayey 10 am.	0·060	0·080	0·040

When the Soils fall below these rough standards, it may be taken as an indication of the ingredient in short supply.

The Tables show the temperature and rainfall as well as the Soil analysis figures for various farms in the area covering roughly about 1,500 acres.

52. The importance of fertilizer grade Ammonium Chloride produced as a co-product of Soda Ash manufacture.

S. V. DESAI, Varanasi.

The search of new nitrogenous fertilizers to augment the fertilizer production in India to meet the growing demand is proving very useful. Ammonium Chloride which can be produced as a co-product of Soda Ash manufacture has assumed an important position in Japan as a non-sulphate nitrogenous fertilizer and is prized for paddy soils when sulphate reduction under anaerobic soil condition damages the roots of Rice Crop.

In India numerous experiments have been carried out at various Research Stations and in cultivators' fields. These experiments show that Ammonium Chloride is as good as Ammonium Sulphate on nitrogen basis for crops. This means that Ammonium Chloride is superior to Ammonium Sulphate by 25% on bulk basis. Small amount of Sodium Chloride which is associated with the product improves the fertilizer value ot the fertilizer.

Continuous use for thirteen years on Sabour farm shows that Ammonium Chloride has no deleterious effect on Soil properties,

AGRICULTURAL CHEMISTRY

53. Estimation of Iron in plant materials by Spectrophotometric method.

BALDEV KAPOOR and C. DAKSHINAMURTI, New Delhi.

Optimum conditions for the estimation of iron in plant materials by sodium salicylate method were worked out using Hilgers' UVISPEK photo-electric spectrophotometer. The colour of the sodium salicylate iron complex was found to give maximum absorption at 5220A°. Colour measurements at zero time were found to be consistent only if the solution is shaken thoroughly before use. With samples of low iron content of the order of 50—100 p.p.m. it is desirable to work with 2·0 gms. of the material while with samples of higher values of iron content, 1 gm. is found to be sufficient. The amount of sodium salicylate required for the correct colour formation is a function of the iron concentration in the extract. Citrus samples with iron contents ranging between 50 and 300 p.p.m. were analysed and the optimum amounts of sodium salicylate solution required were determined.

54. Studies on tree leaves as fodder Banj (*Quercus incana*).

N. D. KEHAR, B. S. GUPTA and K. SAHAI, Izatnagar.

Banj is a large gregarious ever green tree which is found in the temperate Himalayan forest from Indus to Nepal generally between 3000 and 8000 ft. above sea level. The bark yields a reddish colouring matter which is used for dyeing silk and cotton. The leaves are lopped for feeding cattle.

The percentage chemical composition of green Banj leaves, crude protein, 10·20; ether extract, 4·84; crude fibre, 31·34; total ash, 5·24; nitrogen free extract, 48·38; calcium (CaO), 1·39; phosphorus (P_2O_5), 0·35.

To determine the nutritive value these leaves were fed ad. lib. to six Kumaoni bullocks for 46 days the last 10 days of which constituted metabolic period. On dry basis, the bullocks on an average consumed 2·2 lbs. leaves per 100 lbs. of live weight which is fairly high figure and indicative of the high palatability of these leaves.

In the metabolic trial conducted on the Kumaoni bullocks the average percentage digestibility of crude protein, ether extract, crude fibre and nitrogen free extract, were found to be 56·5, 28·5, 27·2 and 54·5 respectively. The figures for crude protein and nitrogen free extract are high while that of ether extract and crude fibre are bit lower. The digestible crude protein, total digestible nutrients and starch equivalent values in lbs. per 100 lbs. of dry leaves, worked out to be 5·76, 43·75 and 23·76 respectively.

The balances for nitrogen, calcium (lime), P_2O_5 (phosphorus) were positive which agrees with the average increase in live weight recorded by the animals at the end of experiment.

It may be concluded from these observations that Banj leaves are highly palatable and fairly rich in all essential nutrients.

55. Palatability, chemical composition, digestibility and nutritive value of sainjana (*Moringa oleifera*) leaves.

N. D. KEHAR, M. M. JAYAL and B. S. GUPTA, Izatnagar.

Moringa oleifera is a deciduous tree which grows in the sub-himalayan tract and is also cultivated.

The percentage chemical composition on the basis of dry leaves was found to be, crude protein, 15·62; ether extra, 4·35; crude fibre, 17·89; nitrogen free extract, 48·71; total carbohydrates, 66·60; ash, 13·43; CaO, 4·50 and P_2O_5, 0·65.

For determining the nutritive value, sainjana leaves were fed as sole feed to six sheep throughout the feeding trial. The average digestibility coefficients of sainjana leaves were found to be, crude protein 71·0; ether extract, 30·7; crude fibre, 57·8 and nitrogen free extract, 76·1. The values of digestible crude protein and total digestible nutrients in lbs. per 100 lbs. of sainjana leave on dry basis, were found to be 11·09 and 61·49 respectively.

The balances for nitrogen, calcium and phosphorus were positive.

The observations indicate that sainjana leaves are quite rich in the essential nutrients.

56. Retting of Jute : VI. Effect of soluble matters present in jute bark on the retting period.

A. K. KUNDU, G. HALDER and M. K. MUKHERJEE, Barrackpore.

The separation of fibre mainly depends upon the breakdown of hemicelluloses and pectins. Nitrogenous compounds, carbohydrates and glucosides, etc. also play an important role in the process. It has been found that if the water soluble substances are removed, the retting period is increased by 78%, whilst on addition of these substances the retting period is lowered by 43%. This shows that due to the removal of water soluble substances, the favourable conditions for the growth of micro-organisms are disturbed. On addition of ammonium sulphate, and peptone, it has been found that even in treatments from which water soluble substances are removed, the retting period is considerably lowered, but the lowering is much less with dextrose. This is due possibly to the fact that the pectins and hemicelluloses serve as a source of carbon for the growth of micro-organisms, and this is why retting period is considerably lowered with nitrogenous substances but not so much with sugar.

57. Labile Chlorine method for estimation of Aldrin.

S. K. MAJUMDER, K. S. SRINIVASAN and S. V. PINGALE, Mysore.

Hydrolysable chlorine method for estimating Dieldrin was employed for estimating Aldrin (1, 2, 3, 4, 10, 10-Hexachloro-1, 4, 4a, 5, 8, 8a-hexahydro-1, 4, 5, 8-endo-exo-dimethanonaphthalene). One mole of chlorine was dehydrochlorinated from Aldrin with monoethanolamine as the dehydrochlorinating agent in evacuated sealed tubes at 130°C for 16 hours. The possibility of estimating Aldrin has been indicated by the hydrolysable chlorine method. Since only one chlorine mole out of six is labilized under the experimental conditions the method may not be applicable to the determination of microquantities.

58. Studies on the composition of some cereal straws in Kaira district.

B. M. PATEL, B. G. SHAH, P. S. PATEL and P. C. SHUKLA, Anand.

Samples of fodders of summer and kharif bajri (*Pennisetum typhoideum*), early and late paddy and *Kodra* (*Paspalum serobiculatum*) were collected at different stages of maturity from four villages selected at random and were analysed with a view to study the change in composition with growth. The straws of different seasons, years and varieties have also been compared.

In all the fodders crude protein and ether extract decrease with maturity while crude fibre increases. Phosphate tends to decrease as the plant grows but the variations in calcium content are irregular.

A comparison between summer and kharif bajri straw reveals that the latter is more fibrous and poorer in calcium. The summer bajri straw is richer in ether extract and N.F.E. also.

When the straws of different crops collected in 1952, 1953 and 1954 are compared, it is found that the samples collected in 1952 were richer in minerals and less fibrous than those collected in 1953 and 1954. It may be attributed to the heavier rainfall in the latter two years.

Between the straws of early and late varieties of paddy there are no significant differences.

59. Some chemical characters influencing burn in flue-cured tobacco.

K. V. VENKATARAMAN and K. G. TEJWANI, Rajahmundry.

Leafburn, an important quality factor in any smoking tobacco, is measured in terms of time for which a leaf will continue to burn or glow without free fire and coaling, when ignited at threshold temperature of ignition, and is a factor largely influenced by the chemical composition of the leaf. These studies were initiated following frequent reports about the poor burning qualities of the Indian flue-cured tobacco. A set of 43 samples varying very widely in both leafburn and chemical composition were used for the study. A multiple regression equation for the expression of leafburn with K_2O, CaO, MgO, N and Cl as the variables was constructed. Sulphur and P_2O_5 were not included in the study as they showed very little variation in these samples. The results indicated that potash was beneficial for burn, while magnesium, nitrogen and chlorine were detrimental to it. Calcium had very little direct influence on burn. The highly significant coefficient of multiple correlation of 0·80 and the coefficient of determination $R^2=0{\cdot}64$ indicate that 64% of the variations in burn are associated with variations in the above chemical constituents. As the mean and percentage content of these constituents varied widely, the overall partial influence of each of these constituents on leafburn, as also their relative effects were studied by expressing the various partial regression coefficients in terms of their standard deviation from the mean. From a comparison of these standard coefficients it is observed that the deleterious effect of nitrogen is nearly three times that of either chlorine or magnesium or 1·12 times the beneficial effect of potassium. The significance of these studies in the production of flue-cured tobacco of good quality with special reference to the factors to be taken into consideration in the fertilisation of the crop has also been discussed.

DISEASES AND PESTS

60. Apple Mosaic in fruit orchards of Kumaon.

K. S. BHARGAVA and N. S. BISHT, Nainital.

In the year 1956 apple mosaic was found in many orchards of Kumaon hills. Symptoms produced by the disease are vein chlorosis, small irregular creamy or yellow spots on the leaf or necrosis due to heavy chlorosis. The presence of virus was confirmed by transmitting the disease by budding or grafting. This is the first record of this disease in the country.

61. A Virus Disease of Tomatoes in Field.

K. S. BHARGAVA and R. D. JOSHI, Nainital.

A serious disease of tomato plants has been observed in the fields at Haldwani and at Jakh (Nainital). The affected plants are dwarfed and malformed. The lamina of the leaves are much reduced and show 'Fern leaf' symptoms. The fruits are fewer and smaller in size.

The causal agent has been identified as a strain of Cucumber mosaic virus.

The virus appears to over winter in volunteer tomato plants left over from the previous crop or other cultivated plants such as Cucumbers, *Solanum melongena, Capsicum* sp., Spinach and 'Chua'. These plants have been shown to be susceptible to this virus. It is believed that aphids are the main vectors of the disease to the cultivated crops.

62. The Mustard Aphid and its control.

O. S. BINDRA and D. K. SAXENA, Gwalior.

Rhopalosiphum pseudobrassicae Davis is a serious sap-sucking pest of mustard and other Crucifers besides being a transmitter of at least four plant viruses. In Gwalior its attack begins as *Sexuales* in December and it damages the crop as *Fundatrices* and *Fundatrigeniae,* the latter giving rise to *Migrantes* towards the end of February and beginning of March. The Migrantes cannot perpetuate on mustard and must migrate to some secondary host.

The three predators, namely, *Coccinella septempunctata* Fab., *Sphaerophoria scutellaris* Fab. and *Lecopis griseola* Fab. which are quite common, and the cultural practice of sowing mustard as a mixed crop are not good enough for its satisfactory control. Trials have been conducted on its insecticidal control, and the effect of the insecticides on the grown up grubs, pupae and adults of *C. septempunctata* Fab. has also been studied using DDT, BHC, Basudin, Folidol E-605, Endrin, Metasystox, Pyrocolloid, Nicotine Sulphate and Lethane B-72. The results show that Metasystox 0·025 and 0·037 per cent and DDT 0·2 per cent are effective against the aphid and do not kill the Coccinellid predator. On the basis of effectiveness for aphid control, non-toxicity to predators, systemic action and cheapness over DDT, 0·025% Metasystox spray may be recommended for the control of this pest.

63. Influence of varieties of *Hibiscus cannabinus* and *H. sabdariffa* on the incidence of *Agrilus acutus.*

N. DUTT and S. P. BHATTACHARJEE, Barrackpore.

Six different varieties of *Hibiscus cannabinus* viz., M.T.-129, M.T.-102, M.T.-128, M.T.-166, M.T.-150 and M.T.-15 were tested, in a replicated randomized field trial, for their varietal difference on the incidence of *Agrilus acutus.* Of these, M.T.-15 has been isolated at the Jute Agricultural Research Institute from an indigenous material while the others are exotic types. No incidence of the pest was observed in any of the varieties during the first month's stage of growth. In subsequent stages of growth, M.T.-15 showed consistently lower incidence in comparison with other varieties but the difference was significant during the 4th month stage at 1% level.

In a similar trial carried out with four varieties of *H. sabdariffa* viz. *altissima,* R.T.-26, R.T.-2, R.T.-1, no incidence was recorded up to the third month stage of growth. During the 4th and 5th month, incidences were observed in all the varieties but the differences were insignificant, though incidence per cent was much less in variety R.T.-1.

Incidences of the pest was much higher and recorded much earlier in all the varieties of *H. cannabinus* than those of *H. sabdariffa* indicating a definite preference of *cannabinus* types over the *sabdariffa* varieties.

64. Transmission of Chlorosis in Jute.

T. GHOSH and M. BASAK, Barrackpore.

Investigations continued from 1949 showed that Chlorosis (yellow mosaic) in *C. capsularis* Linn (Jute) is transmissible through graft. It was further seen that pollen could transfer the disease. It could not, however, be transmitted by the usual technique of smearing leaf extract on healthy plants. The disease seems to be due to a virus which spreads through pollen i.e. through seed. Insect vector is absent.

65. Tip-rot of Mesta, (*Hibiscus cannabinus* Linn).

T. GHOSH and N. MUKHERJI, Barrackpore.

Mesta, *Hibiscus cannabinus* Linn has been found to suffer from a new disease termed 'Tip-rot', in which the tip of the growing stem withered and turned brown to black. The disease has been found to be associated with a species of *Trichosphaeria*, the pycnidial form of which is a Phoma. The wild species of *H. radiatus* was found immune while most of the types indigenous or exotic were susceptible. The F_4 of the interspecific cross between *H. cannabinus* and *H. radiatus* was found resistant in 1956. The F_4 were obtained from a single surviving plant from the F_3 which was severely attacked by tip-rot in 1955. Selections were carried forward for studies in 1957.

66. Persistence of DDT residue on Apple fruit in the hills of Uttar Pradesh.

K. M. GUPTA, Chaubattia and S. V. PINGALE, Mysore.

Since fruits containing more than 5 parts of DDT per million parts of fruit are not considered safe for human consumption, investigations were undertaken at Chaubattia during July-August 1956 to know the persistence of DDT used as emulsion on apple fruits. Chemical analysis of treated fruits with an initial deposit of 16 parts DDT showed a residue of 7·7, 6·4 and 4·1 parts for whole fruit; 5·1, 2·8 and 1·6 parts for washed fruit; and 1·7, 0·0 and 0·0 parts for peeled fruit, respectively, after an exposure of one, two and three weeks to natural weather conditions. Table showing the amount of DDT contained in the fruit at various intervals of exposure, meteorological observations and remarks of the taste panel are appended.

67. Safflower aphids *Macrosiphum sonchi* and its control with organo-phosphorous insecticides.

MOHD QADIRUDDIN KHAN and MASOOM HUSSAIN, Hyderabad-Dn.

Safflower (*Carthamus tinctorius*) is an important oilseed crop. About a dozen insect pests attack this crop, but two of them viz., Safflower aphids, *Macrosiphum sonchi* and *Perigea capensis* are very important. Out of these two the *Macrosiphum sonchi* is very serious. The yield of the affected crop is generally reduced by 20 to 25%. The control of the pest by Nicotine Sulphate, DDT and BHC is not complete and a few aphids that survive gradually multiply and reinfest the crop necessitating further treatment. Organo-phosphorous insecticides viz. Basudin, Folidol E-605, Systox and Metasystox were tried against the Safflower aphids.

Among the different formulations of four organo-phosphorous insecticides, Folidol E-605 (0·02% conc.), Systox (0·021% conc.), Metasystox (0·03% conc.) and Basudin (0·013% conc.) gave 100% kill of all stages of Safflower aphids within twenty-four hours. Aphid re-infestation in case of Systox, Metasystox and Basudin started a week earlier than in Folidol sprayed plots. It was also found that the rate of re-infestation and multiplication of aphids was more in the Basudin treated plots.

68. Effects of pre-harvest foliage sprays of Maleic Hydrazide on the cold-storage behaviour of Onions.

P. B. MATHUR, W. B. DATE, H. C. SRIVASTAVA and
H. SUBRAMANYAM, Mysore.

Onion bulbs, the tops of which had been sprayed 18 days before harvest with 200, 400 and 600 p.p.m. of maleic hydrazide solution, together with a control were stored at two temperature ranges, viz., 59-87°F (R.H., 45-78%) and 32-35°F (R.H., 80-90%). Treatment with the hormone resulted in inhibition of rooting and sprouting and a reduction in wastage due to fungous diseases of the onion bulbs during storage at both the temperature ranges investigated. It is suggested that this treatment can be profitably employed in India to reduce the wastage during the storage of onions.

69. Studies on the egg-parasites of *Tessaratoma javanica* Thunberg, a pest of *Schleichera oleosa* (Lour.) Merr., with special reference to *Anastatus colemnai* Crawf. (Eupelmidae).

B. P. MEHRA, Ranchi.

The genus *Anastatus* is an important genus as it represents a large number of wasps parasitic on various plant and other pests. Over fifty species of this genus have so far been described and reported. Members of this genus are mostly egg-parasites of Lepidoptera, Orthoptera, Hemiptera and Coleoptera. *Anastatus colemani* Crawf, *A. blattidarum*, Ferr. and *A. coimbatorensis* Gir are so far recorded from India. *A. colemani* Crawf, *Anastatus* sp. and two species of *Ooencyrtus* were observed as egg-parasites of *Tessaratoma javanica* Thunberg during the course of investigations on the control of the latter which occurs as a sporadic pest of *Schleichera oleosa* (Lour.) Merrs., a major lac host in India. Detailed studies were carried out in the case of *A. colemani* and descriptive notes of field and experimental parasitisation, oviposition behaviour and the development stages of *A. colemani* are given. The life-history studies of this parasite have indicated that the total life-history period varies between 16-17 days during March to November and 135 days during October to March when it goes into hibernation. They lived longer in experimental field cages in their natural habit than in the laboratory. It has 9 or 10 generations depending whether the severe winter intervenes in the 9th or 10th generation. The last generation is always the longest. Possibility of employment of this parasite for the biological control of *T. javanica* is discussed.

Some observations on three egg-parasites namely an *Anastatus* sp. and two *Ooencyrtus* spp. are recorded.

70. Some laboratory tests on the control of Khapra grubs with Pyrethrins.

P. B. MOOKHERJEE and G. C. SHARMA, New Delhi.

In India, Khapra (*Trogoderma granarium* Everts) constitutes a major pest of wheat and other cereals. The damage, as is well known, is caused in the larval stage and it is also in this stage only that the pest survives for long periods if food is not available or unsuitable temperature conditions prevail. Unlike the adults, the control of the Khapra grubs has unfortunately remained a most difficult proposition till today. The grubs, presumably because of its hard cuticular structure, has so far resisted most insecticidal treatments and fumigation seems to be the only method to give some control of the pest at the present moment. Fumigation of the pest is, however, difficult to be followed at all places, particularly in stores of rural India. It was, therefore, thought desirable to make some tests with pyrethrum, which is relatively non-toxic to human beings and cattle and see how far this insecticide could be used for the control of the Khapra grubs.

Some work along this line has been in progress in the division of Entomology, I. A. R. I. The earlier attempts to control the pest by means of pyrethrins emulsion from a proprietary formulation of the insecticide in kerosine extracted gave slightly encouraging results and a 0·7% emulsion spray accounted for 63% kill in course of ten days, there being knock-down effect in 24-48 hours in these cases and the sprayed grubs being allowed to remain in the petri dishes that were also sprayed. More recent trials with pyrethrins emulsion made in the laboratory out of a petroleum ether extract of the insecticide showed that even as low a concentration as 0·26% could bring about 73% mortality in Khapra grubs when sprayed directly without any film effect. The mortality was even higher (100%) when the sprayed grubs were also left in contact with a glass surface similarly sprayed. It was further observed that in combination with 1% piperonyl butoxide, a 0·25% pyrethrins emulsion could bring about as much as 95·5% mortality when directly sprayed without any film effect while a still lesser dose of 0·1% pyrethrins in combination with 2% piperonyl butoxide also accounted for 85% mortality under similar conditions. Further work is in progress.

71. Notes on some fungi from Orissa—I.

U. N. MOHANTY and N. N. MOHANTY, Bhubaneswar.

The paper deals with the descriptive notes of 5 different species of fungi hitherto unreported from India along with the symptoms they cause on their respective hosts. Out of these, two species namely *Biharia aegles* and *Cercospora fistulae* are new species causing leaf spot diseases on *Aegle marmelos* Correa and *Cassia fistula* L. respectively. The rest three species namely *Cercospora avverhoae*, *Cercospora fukushiana* and *Stemphylium solani* which cause leaf spots on *Averrhoa carambola* L., *Impatiens balsamina* L. and *Capsicum annum* L. respectively are new records from India.

72. Fumigation of infested wheat with Carbon Tetrachloride.

E. S. NARAYANAN, S. PRADHAN, H. J. BHAMBHANI and S. K. BHATIA, New Delhi.

Wheat in storage is infested by *Trogoderma granarium*, *Tribolium castaneum*, *Rhizopertha dominica*, *Calandra oryzae* etc. *T. granarium* is the most resistant insect attacking wheat. Every year in India these insect pests cause damage worth millions of rupees. Experiments carried out to find a suitable fumigant which is toxic enough to kill the insect pests of storage and is safe to the operator have established the superiority of carbon tetrachloride against *T. castaneum* adults over EDCT mixture ('Chlorosol' or Killoptera) which is being used throughout India at present and also over ethylene dichloride. The investigations have also revealed that this fumigant can penetrate the column of wheat and is comparatively less absorbed. (Narayanan, Pradhan, Bhambhani—1956). A few experiments were therefore carried out on a large scale with carbon tetrachloride in 100 cu. ft. cement concrete fumigatorium to test its efficacy against some common stored grain pests like *T. castaneum* and *R. dominica.* 12-13 bags of infested wheat were fumigated each time and it was found that a dosage of approx. 8 lbs per 1000 cu. ft. for 24 hours gave 100% mortality of the above mentioned pests. Further it may be pointed out that carbon tetrachloride when used even at the rate of 7-8 times the effective dose for 24 hours or at the rate of 7·5 lbs. per 1000 cu. ft. for 8 days does not impair the germination of wheat seed. Carbon tetrachloride is free from fire and explosion hazards, safe to handle, easy to use and cheap.

73. Biology and Morphology of *Brachymeria* Sp. (Chalcidae : Hymenoptera), a parasite of *Metriona circumdata* H.

E. S. NARAYAN, B. R. SUBBA RAO, and R. B. KAUR, New Delhi.

Metriona circumdata, H. a chrysomelid beetle is a minor pest of sweet potato in India. The grubs of the beetle feed on the green matter of the leaf which they skeletonize. A chalcid parasite *Brachymeria* sp. has been reared from the grubs and its biology and bionomics studied in detail. The parasites first make their appearance in the field in the last week of October and remain upto the first week of December. Mating is very peculiar as the male does not mount on the female, but supports itself on its strong hind lengs, bringing the abdomen in front for mating. Younger stages are preferred for oviposition. Usually one egg is laid at a time but two have also been observed. However, only one completes its development. The life cycle varies from 17 to 20 days under laboratory conditions. The freshly laid egg is smooth and crescentic in shape. The incubation period is only a few hours. There are five larval instars and the larval period varies from 8 to 11 days. Spines are present only in the second instar on all the abdominal segments. Respiratory system is interesting. Nine pairs of spiracles make their appearance in the third instar and they open only in the last instar. Clusters of spicules are irregularly distributed in the fifth instar. The parasite larva allows the host to pupate first and then moults itself into fifth instar. After completing the feeding it pupates within the puparium of its host. The pupal period is about 9 days. The late pupa is brownish yellow. The adult emerges by biting a hole at about the middle of the dorsum of the pupal shell and is jet black in colour. Sexes occur approximately in equal numbers. The percentage of parasitism was very high in the 1956 season.

74. Comparative toxicity of some important insecticides to *Cylas formicarius* Fabr. and *Mylloceru maculosus* Desbr. (Curculionidae-Coleoptera).

S. PRADHAN, M. G. JOTWANI and B. K. RAI, New Delhi.

The bioassay of laboratory formulated insecticide emulsions used against adults of *C. formicarius* and *M. maculosus,* both belonging to the same family Curculionidae showed that in the case of *C. formicarius* all the insecticides tested were far more toxic than DDT. The respective toxicities of parathion, diazinon, systox, endrin, isodrin, lindane, malathion, dieldrin, aldrin and chlordene being: 1153·5, 985·7, 559·3, 272·0, 224·1, 108·4, 108·1, 58·1, 56·5 and 7·7, taking the toxicity of DDT as 1·0. In the case of *M. maculosus* on the other hand, DDT was found to be more toxic than all the insecticides tried except malathion and parathion. Lindane, systox, diazinon, endrin and aldrin being respectively, 0·918, 0·515, 0·481, 0·355 and 0·169 times as toxic as DDT, while malathion and paration were 1·940 and 1·786 times respectively as toxic as DDT. These wide variations in the susceptibility of the two weevils belonging to the same family affords an interesting example of specificity of the action of insecticides.

75. Organic insecticides for the control of Fly Breeding in Compost.

S. PRADHAN, P. B. MOOKHERJEE and M. K. K. PILLAI, New Delhi.

A good deal of attempt has been made in India and abroad for the control of flies in compost pits but the desired degree of success has not yet been achieved. Hence some small scale pit experiments were carried out using a few of the modern organic insecticides viz. DDT, γ-BHC, aldrin, endrin and malathion. The pits were filled with fresh cattle dung and then a known number of fly maggots were introduced into these pits. Subsequently the surface of the pits were dusted with these insecticides. Observations showed that except for 2·5% DDT, all the other insecticides used at a concentration of 0·5% (γ-BHC at 0·13% only) and applied at 2 ozs. per pit which was 1′×1′ in surface area and 2′ deep produced significant reduction in the emergence of the flies from the pits. The emergence of the flies during the whole course of experimentation ranged from 30·8% to 45·8% in the control pits as compared to only 0·17% to 15·32% in the various dust treatments except DDT. The control achieved with these insecticides was also better than with other known mechanical methods of control like mud plastering and use of tarred cloth. There was, however, no significant difference between the relative efficacy of the various insecticides except DDT. In one experiment the insecticides were applied in three layers i.e. one layer at the top and two other successive layers at 2″ and 4″ depths from the top at the rate of 1 oz. per layer and it was found that the control of fly emergence was comparatively better as a result of this modification. Covering the manure pits with a layer of sand was curiously found to increase fly-emergence.

76. Relative toxicity of films of some organic insecticides to three species of Coleopterous pests of stored grain.

S. PRADHAN and PRAKASH SARUP, New Delhi.

This contribution reports the relative toxicity of films of six insecticides to adults and larvae of *Latheticus oryzae* Waterh., adults of *Rhizopertha dominica* Fabr. and five insecticides to the adults of *Calandra oryzae* Linn. The values of relative toxicity have been worked out on the basis of L. C. 50 and taking that of DDT as one. In the case of *Latheticus oryzae* Waterh., 'adults' the values of relative toxicity were found to be: BHC—5·12, endrin—1·93, dieldrin—1·48, toxaphene—0·819 and aldrin—0·319. Similarly in the case of larvae of *Latheticus oryzae* the values were: endrin—9·36, dieldrin—7·21, BHC—6·76, aldrin—1·78, and toxaphene—0·99. All the insecticides tested were far more toxic than DDT to adults of *Rhizopertha dominica.* The values of relative toxicity of endrin, BHC, dieldrin, aldrin and toxaphene being 13·47, 9·55, 4·41, 2·09, and 1·05 respectively. In the case of adults of *Calandra oryzae* the values of relative toxicity of different insecticides were: dieldrin—46·78, BHC—36·64, endrin—18·11 and toxaphene—0·99.

77. An annotated list of insect parasites of Crop-pests in Orissa.

G. C. SENGUPTA, Bhubaneswar and B. K. BEHURA, Cuttack.

An annotated list of 25 insect parasites of insect pests of crops in Orissa is given. Mention may be made of *Microplitis maculipennis* Szep. on *Achaea janata* L.; *Apantales flavipes* Cam., *Stenobracon deesae* Cam., and *Goniozus indicus* Ashm. on *Chilotrea infuscatella* Sn., *Scirpophaga nivella* F., and *S. rhodoproctalis* F., *Agathis* (*Microdus*) sp. on *Dichocrocis punctiferalis* Guen.; *Uga* sp. n., *Pediobius* (=*Pleurotropis*) *epilachnae* Rohw. and *Tetrastichus ovulurum* Ferr. on *Epilachna 28-punctata; Cremastus flavo-orbitalis* Com. on *Euzophera perticella* Rag.; *Secodella* sp. on *Exelastes atomosa* Wlsm.; *Syrphophagus* sp. on *Lema semiregularis* Jac.; *Apantales taprobanae* Cam. on *Heliothis armigera* Hb.; *Euplectrus coimbatorensis* Ferr. on *Laphygma exigua* Hb.; *Phanorotoma* sp. on *Ctenomeristis ebriola* Meyr.; *Apanatales stantoni* Ashm. on *Margaronia caesalis* Wlk.; *Microplitis* sp. on *Prodenia litura* F.; *Platygaster oryzae* Cameron on *Pachydiplosis oryzae; Tetrastichus pyrillae* Crwf. on *Pyrilla perpusilla* Wlk.; *Stenobracon* (*Bracon*) *nicevillei* Bingham and *Elasmus zehntneri* Ferr. on *Scirpophaga nivella* F., and *S. rhodoproctallis* F.; *Rhaconotus scirpophagae* Wlk. and *R. roslinensis* Lal (*caulicola* Mues.) on *Scirpophaga rhodoproctalis* F.; *Diocles vulgaris* Morley and *Brachymeria* sp. on *Udaspes folus* Cr.; and *Trichogramma minutum* Riley on *Chilotrea infuscatella* Sn. and *Scirpophaga rhodoproctalis* F.

78. Tests of some insecticides to control Epilachna 28-punctata F. (Coccinelidae).

G. C. SENGUPTA and N. PANDA, Bhubaneswar.

The coccinellid beetle (*Epilachna 28-punctata* F.) has become a limiting factor in the economic production of Brinjal (*Solanum melongena*) in the State of Orissa.

In experiments conducted at State Agricultural Research Station, Bhubaneswar in 1956 against this pest on brinjals Endrin 19·5% emulsion concentrate when applied at 0·019% Concentration proved more effective than DDT and Dieldrin 50% wettable powder applied at 0·0625% Concentration. At the same strength Dieldrin 50% wettable powder gave slightly better result than DDT. In one experiment though Malathion 25% wettable powder applied at 0·0625% Concentration proved as effective as Endrin 19·5% emulsion concentrate applied at 0·019% Concentration, it failed to give the same results in other two experiments as there was heavy rainfall within 24 hours after the application of the insecticides. Malathion 25% wettable powder is apparently lass persistent than other insecticides used in this experiment. Further work for reducing the strength of these insecticides is required.

79. Spraying of Cotton for the control of Jassid and whitefly in the Punjab.

SARDAR SINGH, Ludhiana.

American cotton is the major cash crop in the Punjab. Of the various insect pests, Jassid (*Empoasca devastans* Distant) and whitefly (*Bemisia tabaci* Genn.) and the leafroller (*Sylepta derogata* Fabricius) have inflicted serious losses during the last few years. Cotton growers have become conscious of the effective control measures for their control. Whereas the State Plant Protection Service treated only 1,395 acres of American Cotton in 1955, it had to control these pests over 20,000 acres in 1956 and 50,000 acres in 1957. Ground machinery being inadequate recourse had to be taken to aeroplane spraying. In 1946 about 90 acres were so treated with endrin emulsion at 0·24 lb. actual material per acre by a Hind

Flying Club, Lucknow Piper Super Cruiser at the Modern Cultivators Farm at Lallowali, Fazilka, Ferozepur District. Under the leadership of Modern Cultivators, over 5,300 acres of cotton were sprayed with 0·20 lb. actual endrin per acre by the Government of India aerial unit with a Beaver aero-plane. As an experimental measure, a "Solo" mistblower was used to spray 45 acres with ½ lb. DDT actual and ½ lb BHC actual in 8 to 10 gallons spray material at the rate of an hour an acre. Usual ground spraying was done with one lb. each of DDT and BHC actual at 100 gallons per acre. Almost all adults and nymphs of Jassid and whitefly were killed within 48 hours of spraying.

Parathion at 0·2 lb. actual and malathion at 1 lb. actual per acre were equally effective. However, for keeping the pests under complete check from July to September, it was necessary to follow a fortnightly schedule of spraying with all the insecticides mentioned above. Three sprayings in early July, early August and early September kept the pests fairly under check and also prevented any incidence of the leafroller.

80. A short note on the control of Cotton Thrips (*Thrips tabaci* Lind).

SARDAR SINGH and AJIT SINGH SIDHU, Ludhiana.

Thrips on American Cotton are usually considered a minor pest. They appeared in an epidemic form in Ferozepur, Bhatinda, Jullundur, Ludhiana and Patiala districts of the Punjab over vast areas in May, 1957. The first few leaves after the cotyledonary leaves were infested. These leaves were shrivelled badly. The crop gave a sickly appearance and several cultivators ploughed up their fields. Use of DDT 0·1% suspension and nicotine sulphate (1 :1000 parts of water) at 30-50 gallons per acre gave effective control and about 2,684 acres were so treated by the State Plant Protection Service. Copious irrigations coupled with fertilization also helped to save the crop. It is surmised that heavy population of thrips on American cotton this year was due to rather mild, humid and prolonged spring weather as late rains were experienced up to May. Cotton fields next to onion fields invariably showed high incidence of the pest.

Some modern insecticides like Endrin 0·01% and 0·02% emulsion, Malathion 0·05 and 0·1% emulsion and Basudin 0·02 and 0·025% emulsion were tried. DDT 0·1% suspension was kept as the standard and the control plot was sprayed with water. Forty gallons of the spray material was used per acre. Malathion 0·1 and 0·05% emulsion gave 93% and 89% mortality after 48 hours; Basudin 0·025% and 0·02% emulsions gave 100% mortality after 48 hours; Endrin 0·02% and 0·01% gave 100% and 95% mortality after 96 hours compared to cent per cent mortality after a week with DDT 0·1% suspension. Basudin had the maximum knock down effect. DDT 0·1% suspension proved to be the cheapest insecticide, followed by Endrin, Malathion and Basudin; the cost of insecticide per acre being Rs. 1·80, 1·50-3·00, 2·80-5·60 and 4·00-5·00 as compared to Rs. 3·00 per acre with nicotine sulphate and soap.

81. Control of Mustard Aphid (*Rhopalosiphum pseudobrassicae* Davis, Homoptera : Aphididae) by some synthetic insecticides.

SARDAR SINGH and H. S. SIDHU, Ludhiana.

Mustard aphid, *Rhopalosiphum pseudobrassicae* Davis, acts as a limiting factor in the successful production of various cruciferous oilseeds and vegetables. Its control with some of the standard insecticides like Tobacco decoction and rosin compound sometimes leads to uneven results and is often cumbersome. It is rather costly with nicotine sulphate. Some of the new synthetic chlorinated hydrocarbons and phosphatics along with nicotine sulphate and two pyrethrin products were tried on mustard aphid infesting *toria, sarson* and *raya* crops at the Bhupindera Agricultural Farm, Rauni (Patiala) during the winter of 1956-57.

All the insecticides were found to give fairly effective control (80 to 96% after 72 hours of the application) at the concentrations used: Parathion (0·02 and 0·025% suspension); Basudin 0·02 and 0·025% emulsion); Malathion (0·0625% emulsion) Pyrocolloid (1 : 500 parts of water); Pyrocon E (1 : 1000 and 1 : 800 parts of water); BHC (0·25% suspension); Endrin (0·025% emulsion) and Nicotine sulphate 40% (1 : 800 and 1 : 700 parts of water) applied at the rate of 125 gallons per acre on *toria* and *sarson*. Higher concentrations and larger quantities of spray material (180 gallons per acre) were required for suppressing the aphid population on *raya* crop. The cost of various insecticide formulations required to be used per acre varies from Rs. 6·00 in case of Parathion 0·02% suspension at the rate of 125 gallons per acre on *toria* and *sarson* crops to Rs. 57·60 in case of Pyrocolloid (1 :500 parts of water) at the rate of 180 gallons per acre on the *raya* crop as compared to Rs. 16·75 for nicotine sulphate 40% (1 :800 parts of water plus 1 part of sunlight-soap in 200 parts of spray material) at the rate of 125 gallons on *toria* and *sarson;* and Rs. 26·28 for the same at a higher concentration (1 :700 parts of water plus 1 part of sunlight-soap in 200 parts of spray material) at the rate of 180 gallons per acre on the *raya* crop. Among the chlorinated hydrocarbons BHC 0·25% suspension at the rate of 125 gallons per acre on *toria* and *sarson* and 180 gallons per acre on *raya* crop (6·25 lbs-9 lbs. of BHC 50% W. P. per acre) is the most economical. It is recommended for use on crops which are not to be used for edible purposes as fodder for cattle or *sag* for culinary purposes. Among the phosphatics, Parathion 0·02% suspension at the rate of 125 gallons per acre on *toria* and *sarson* and its higher concentration 0·025% suspension at the rate of 180 gallons per acre for *raya* is the cheapest and most effective insecticide but it can be recommended for use by people who are capable of appreciating the toxicity hazards involved in the use of Parathion. Malathion 0·0625% emulsion at the rate of 125-180 gallons per acre is suggested for general adoption as its toxicity is one thirtieth to one hundredth of Parathion. It gives a fairly high degree of control of aphids and is reasonably priced. Basudin is the costliest of the phosphatics and its use has to avait until the manufacturers are able to market it more cheaply.

In view of the high multiplication rate of aphids, it is necessary to put on several applications of the spray material on the precious cruciferous crops to keep them reasonably clean of aphids. Further work in finding out such a spray schedule is underway.

82. Bionomics and Control of *Athalia proxima* Klug. (Hymenoptera : Tenthredinidae).

GURUCHARAN SINGH SOHI, Ludhiana.

Athalia proxima Klug. (Mustard sawfly) is an important pest of young cruciferous plants, especially the turnips and radish and is met with in practically all the districts of the Punjab.

The eggs are laid singly in slits made by the female with the help of her saw-like ovipositors along the margin of the leaf on its lower surface. The eggs hatch in 4-8 days. The newly hatched grubs start feeding on the foliage and bite holes of varying sizes in them. Tender leaves are preferred by the insect, but in severe cases of infestation, the grubs even feed on the rind of the stem or branches of the plant. The grub undergoes six moults and completes its larval stage in 16-35 days when it enters the soil to a depth of 1-1½ inches and prepares a silken oval cocoon in which it transforms itself into a pupa. The pupal stage lasts for 11-31 days depending upon the season. Two to three hours after emergence, mating takes place and the female adults start ovipositing eggs usually an hour after copulation. A female, on an average lays 30-45 eggs. The longevity of the female adut varies from 2-8 days as against 1·8-5·8 days in case of male.

The insect aestivates as a grub, in a silken cocoon in the soil from end of February to the end of September when it starts pupating. The period of activity extends from September to January. The insect passes through three overlapping generations in a year.

Of the various insecticides tried, Benzene hexachloride suspension in water containing 0·2% BHC proved effective and economical for its control.

83. Effect of different host species on the oviposition of *Callosobruchus chinensis.*

B. K. SRIVASTAVA and S. K. BHATIA, New Delhi.

Experiments were set up in which adults had a choice of hosts for oviposition. Ten grams each of different seeds were weighed and arranged alternately in 6″ petri dishes leaving ¾″ circular space in the centre. Counted number of newly emerged pairs of the beetle were released in the centre. After five days the number of eggs laid on each seed species were counted.

The results showed that the beetle lays more eggs on smooth seeds with well glled seed coat such as soy bean (*Glycine max*), kidney bean (*Phaseolus vulgaris*), cluster bean (*Cyamopsis tetragonoloba*), hyacinth bean (*Dolichos lablab*), sword bean (*Canavalia gladiata*) and cowpea K 700 (*Vigna sinensis*) in comparison to cowpea desi, chick pea (*Cicer arietinum*), broad bean (*Vicia faba*) and garden pea (*Pisum sativum*) which had depressed, wrinkled or rough surfaces. However, this preference cannot be attributed to the smoothness of the seed alone since the beetle refuses to lay eggs on smooth cucurbit seeds but oviposits freely on okra seeds (*Abelmoschus esculentus*). This preference for oviposition shown by the beetle does not seem to have any relation with the suitability of the seed for the development of the insect. It was further observed that the bigger the size of the seed the more the number of eggs laid per seed. The fecundity of the beetle is increased with the choice seeds when allowed to oviposit separately.

84. Testing certain vegetable seeds as hosts of *Callosobruchus chinensis*

B. K. SRIVASTAVA and S. K. BHATIA, New Delhi.

During the survey and certification work of vegetable seeds the pulse beetle, *Callosobruchus chinensis* has been intercepted from sword bean (*Canavalia gladiata*), hyacinth bean (*Dolichos lablab*), cowpea (*Vigna sinensis*), cluster bean (*Cyamopsis tetragonoloba*), broad bean (*Vicia faba*), kidney bean (*Phaseolus vulgaris*), chick pea (*Cicer arietinum*), garden pea (*Pisum sativum*), and soy bean (*Glycine max*). It was observed that the beetle laid eggs freely in all these seeds but its further development was not uniform in the different seeds. In some it developed very fast while in others it could hardly subsist and even died without entering the seed. These general observations led to the experimental determination of the fact. The ability of this beetle to reproduce in and damage these seeds was judged by the growth index which was calculated by dividing the percentage of eggs becoming adults with the average time taken to complete the development.

It was found that in sword bean, hyacinth bean, cluster bean, kidney bean and soy bean the eggs did not produce adults. The newly hatched larvae were unable to penetrate the seed coat in cluster bean and died within the egg shell. In the remaining immune seeds they penetrated only upto a pin point and died without any further development. Among the susceptible seeds the growth was very fast in cowpeas and chick pea with growth indices varying from 3·6 to 3·9 but slow in garden pea where the growth index was 1·0. Broad bean with an index value of 0·1 proved worst where the rate of growth and survival of the insect was very unsatisfactory.

85. Effect of fungicides on the germination of the spores of *Cercospora arachidicola* causing 'Tikka' on Groundnut.

D. V. SUBBA RAO and SYED VAHEEDUDDIN, Hyderabad-Dn.

Five fungicides were tested in a rapid laboratory slide method recommended by the American Phytopathological Society's Committee on the standardization of fungicidal tests. The fungicides Perenox, Agricop, Wetcol-15 and Dithane-Z-78 along with copper sulphate were used instead of standared Bordeaux mixture at four levels i.e. 0·25%, 0·50%, 1·00% and 1·50% of the active ingredients of the chemicals were tried. Dextrose sugar solution (2%) was used along with the standard drops of spores suspension as an acceleration for inducing higher percentage of germination.

At 1·5% level of the active ingredients of all fungicides tried a dosal inhibition of the spores, resulting in negative germination of the spores of *Cercospora arachidicola* was noticed. For all practical purposes, there seems to be no need of going beyond the 1·50% active ingredient level for all funfiicides, as no germination was observed and total inhibition of spores occurred. The inhibition of spores was progressively higher resulting in lower percentage of the germination of the spores as the percentage of active ingredient of the fungicides tried was more. The effect of all the fungicides significant in inhibiting the spores, resulting in lower percentage of germination. Among the fungicides, total inhibition of spores i.e. no germination of spores was observed in case of Perenox tried at 1·0% level of the active ingredient, while other fungicides at the same level showed 0·39%—1·53% germination. No significant difference among the different fungicides was observed.

86. Effect of dextrose sugar solution on the spore germination of *Cercospora arachidicola* causing leaf spot disease on groundnut.

D. V. SUBBA RAO and SYED AHEEDUDDIN, Hyderabad-Dn.

Leaf spot of groundnut caused by *Cercospora arachidicola* occurs in its very severe form in the erstwhile Hyderabad State. During the month of September it reaches to epiphytotic stage and causes losses ranging from 15-25% in the yields. The spores of the organism readily germinate in tap water in 8 hours at room temperatures (76°F) when kept in moist chambers.

In this paper an attempt is made to find out the effect of Dextrose sugar solution on the spore germination of the organism causing the disease.

A uniform spore suspension was made in tap water and with a graduated 1 cc.. pippet two uniform drops were placed on each slide. To this was added with another pippet a drop of Dextrose sugar solution. Different pippets were used for 2%, 5% and 10% sugar solutions. Two such slides for each strength were kept and two more slides with no sugar solutions were kept as controls. To these controls one drop of tap water was added to make the density of the spores uniform in all the slides. These slides were kept in moist chambers and incubated at room temperatures. The minimum and maximum temperatures were 67·3°F and 81°F respectively.

The results of the germination of the spores were recorded in about 10 to 15 microscopic fields at different intervals. A minimum of 100 spores but many a times even more were counted and percentages of germinated spores were calculated. Any spore that gave a germ tube of a length equal to the width of spore was taken as germinated.

The data showed a definite higher percentage of germination of spores in all the strengths of sugar solutious tried. Highest percentage of germinated spores with a sharp rise between 16 and 24 hours was noticed in 2% sugar solution and in case of 10% sugar solution the minimum increase in the percentage of germinated spores was observed. After a period of 24 hours in the percentage of germinated spores, much difference was not observed among the spores germinated in tap water and in 10% Dextrose sugar solution.

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87. The association of ascorbic acid with cotyledon colour in *Cicer arietinum* L.

G. P. ARGIKAR, Karjat.

Since the green-seeded strain of *Cicer* named *Hara-Chana* was found to contain a much higher amount of ascorbic acid than the brown-seeded ones, it was hybridized with a high yielding, bold, brown grained strain C-9 with a view to study the inheritance of ascorbic acid and its probable association with the colour of the testa and cotyledon.

The genetic analysis of the cotyledon and testa colours of the seed of 336 individual F 2 plants is reported along with a study of the ascorbic acid content of the seed of 165 of these plants.

The results of the study reveal an interesting association between Vitamin C and cotyledon colour, the mode of inheritance of the two characters being, therefore, comparable.

The ascorbic acid content of the pre-soaked seed of the green-seeded strain being comparable to that of ripe papaya, tomato and lemons, which are rich sources of vitamin C, it is observed that an inclusion of even one and a half ounces of presoaked grain of this variety would supplement the daily requirement of vitamin C.

88. Radiophosphorus and induced earliness in flowering in *Corchorus olitorius* Linn.

R. K. BASU, Calcutta.

Dry seeds of two cultivated varieties, namely R. 26 and Tall Mutant belonging to the species *C. olitorius* were treated with different initial activities of radiophosphorus, ranging from 15 μc to 1·5 mc for 3, 6, 12 and 24 hours. Some of the plants grown from these irradiated seeds were found to flower significantly earlier than the control while in others, flowering started late. Seeds collected from the early or late flowering plants were grown in the next generation, when significantly earlier flowering were recorded in both the varieties. Statistical analysis revealed significant earliness in both the generations at 0·1% level.

It was concluded that physiological characters can be changed by irradiations with beta rays and the changed features can be successfully introduced in the hereditary mechanism. Another important feature of these early flowering types are, that although the flowering starts significantly earlier than the controls, there was no appreciable suppression of vegetative activity in these plants.

89. Photoperiodic behaviour of an autumn rice.

T. R. DUTTA, Agartala and G. MISRA, Cuttack.

Photoperiodic behaviour of an autumn rice Adt 12 (a selection from Chitrakali of Madras State) has been studied in pot culture experiments. Seedlings were subjected to 8-hour short photoperiod (8 A.M. to 4 P.M.) each day at the ages of 20, 30, 40, and 50 days separately for a period of 30 days in each case. A control set was maintained all along under the natural day length. There was about 13 days earliness in heading in the main shoot which received the treatment at the youngest age of 20 days. With 30-day-old seedlings there was earliness of only 2 days while with further shifting of the treatment-initiation time to 40-and-50-day-old seedlings there was delay in heading by 1 to 2 days. Thus photoperiodic response is different even in the same variety and is dependent on the age of the seedlings at which the treatment is given. The production of tillers was depressed in all the short-day treated sets as long as the treatment was operative. Only in the 20-day-old-seedling set the final number surpassed that of the controls. The final height attained by the plants under 20-and 30-day sets was also more than that of the controls.

90. Studies in the variations of certain internal growth components influencing the yield of Fibre in Jute.

B. K. KAR and B. K. DE SARKAR, Barrackpore.

The fibre yield in jute is positively correlated with height and basal diameter of the stem, which represent externally the total growth of the plant stem. The behaviour of certain internal variates as formation of phleom pyramids, formations of fibre-bundles and fibre layers which are the constituents of fibre growth have not yet been studied. Investigations on the growth and development of the above components during the life-cycle in the varieties D154, Jap Red, (*Capsularis sp.*) Chinsurah Green and JRO-620 (*Olitorius sp.*) have been made. The following results were obtained :—

(1) In D154, a branching type of Capsularis showed to a certain extent greater amount of growth in (a) number of phloem-pyramid formation, (b) fibre bundles, (c) average No. of layers of fibre bundles per pyramid as seen in a T.S.

(2) In Jap Red, a typical non-branching type of Capsularis variety, the constituent structures were developed less in number than D154, although, Jap Red showed greater height and basal diameter than D154.

(3) The average number of fibre bundles per pyramid was found less in Jap Red than in D154 up to 107 days' growth. In later period, though the same was increased considerably in Jap Red, still the total number of phloem pyramids always remained less in Jap Red.

(4) In Chinsurah Green (Olitorius) the constituents were developed more in the early stages (80 days) than JRO-620, but afterwards JRO-620 showed a rapid increase, thereby, showing an increased number of layers of fibre bundles per pyramid.

It is, therefore, evident that internal variates play an important role in the production of fibre, and their growth behaviour indicates a true picture of fibre yielding capacity.

91. Manganese nutrition of plants III. Effects of different concentrations of P and K.

S. C. MANDAL, Kanke.

Two series of solution culture studies were undertaken on the manganese nutrition of pea with varying doses of P, K and Mn. They were named P/Mn series and K/Mn series. In the P/Mn series the concentration of P varied from 310 ppm. to 6·2 ppm., while in the K/Mn series the concentration of K varied from 390 ppm. to 39 ppm. The concentration of Mn varied from 12·5 ppm. to 0·25 ppm. in both the series.

It was observed that at high levels of PO_4'', K+ and Mn++ concentrations the uptake of these ions was high, in general (6500 to 12500 ppm. of P, 8700 to 29000 ppm. of K and 700 to 1700 ppm. of Mn), though high concentrations of Mn++ in the solution reduced the uptake of PO_4''' and K+. It was interesting to note that by increasing the concentrations of PO_4''', a reduction in the uptake of manganese took place, while increments of K+ ions in the solution ordinarily raised the level of manganese nutrition of plants.

High concentrations of manganese in the plant produced toxicity symptoms characterised by chlorosis, necrosis, appearance of reddish brown spots etc. in the younger leaves. High phosphate concentration in the leaves showed itself by bleaching of leaf margins or appearance of white patches in the older leaves. High potassium concentration was not marked by any prominent change in leaf colour. Manganese toxicity due to high Mn concentration was prominent in leaves regardless of P concentration in the plant. On the other hand higher concentrations of K in the plant had a moderating influence on the adverse effects of high manganese concentration in the plant. It was observed that manganese toxicity cannot be correlated to any absolute concentration of manganese in the plant. Plants in the P/Mn series with concentrations of manganese less than 500 ppm. exhibited toxicity symptoms while those in the K/Mn series with higher concentrations of manganese did not show these symptoms so intensely.

92. Effect of some plant growth substances on a mid-winter variety of Rice.

G. MISRA and G. SAHU, Cuttack.

The effect of three plant growth substances IAA, NAA and TIBA at the concentrations of 500, 250 and 100 parts per million (ppm) upon the growth and reproduction of a mid-winter variety of rice has been studied. The treatment consisted of a pre-sowing seed soaking for 72 hours followed by post-sowing weekly foliar spray starting with 28-day-old seedlings till the time of ear emergence. IAA had no effect on flowering and grain yield but brought about some reduction in vegetative growth at seedling stages which, however, vanished with aging of the plants. NAA just like IAA had also no effect on flowering and grain yield, but produced an inhibition on vegetative growth at the earlier stages. The only difference that it produced from IAA is that at 500 ppm concentration it produced a significant increase in height of the mature plants. TIBA, on the other hand, behaved differently from IAA and NAA and brought about a significant earliness in flowering and grain yield at two concentrations of 250 and 100 ppm, while it produced no marked changes in the vegetative growth characters.

93. Effects of different growth regulators on the growth of the pollen tubes of three cucurbitaceous species.

S. K. MUKHERJEE and R. M. DATTA, Calcutta.

In *Luffa acutangula* the pollen tube growth ceases within 3 hours in all cases. In control, the maximum pollen-tube length is 684·3 μ. The maximum growth of pollen tube (1647·80 μ) is obtained at 0·1 ppm of NAA and the minimum (132·82 μ) is obtained at 100 ppm of 2, 4-D among all growth regulators. In PAA, there is no germination at 0·1 ppm. In 3-IAA and Vitamin B_6 the growth rates at four concentrations decrease from first hour to second hour and again increase in third hour except at 10 ppm. In other eight growth regulators (3-IBA, PAA, 2, 4-D, TIBA, a-NAA, d, 1-T, Vitamins B_1 and B_2) the growth rates at four concentrations decrease from first hour to third hour. The abnormalities such as bursting, branching, widening and bulging of the tubes and polysiphony are noticed towards lower concentrations in eight growth regulators except in PAA and vitamin B_2. Vitamin B_1 is the most stimulative; Vitamin B_2, d, 1-T and a-NAA follow next and thirdly 2, 4-D and TIBA. But 3-IBA, PAA, 3-IAA and Vitamin B_6 have retarding effects, mainly the first two.

In *Luffa aegyptiaca* the pollen tube growth ceases within two hours in all cases. In control the maximum pollen-tube length is 591·64 μ. The maximum growth of pollen-tube (902·82 μ) is obtained at 10 ppm of vitamin B_2 and the minimum (186·64 μ) is obtained at 100 ppm of 2, 4-D among all growth regulators.

In 3-IAA, 3-IBA, PAA, TIBA, a-NAA and vitamin B_6, the growth rates at four concentrations are more in the first hour than in the second hour, but growth rates at some concentrations of 2, 4-D, d, 1-T, Vitamin B_1 and B_2 are less in the first hour than in the second hour. The abnormalities such as widening, bulging, coiling of the tubes and polysiphony are noticed towards lower concentrations in eight chemicals except in d, 1-T and Vitamin B_1, 3-IAA, 3-IBA, 2, 4-D, a-NAA, D, 1-T, Vitamin B_1 and B_2 have both stimulating and retarding effects on pollen tube growth, whereas PAA, TIBA and vitamin B_6 have positive retarding effects.

In *Momordica charantia* pollen tube growth ceases within two hours in all cases. In control maximum growth is 481·61 μ. The maximum tube growth (886·65 μ) is obtained at 1 ppm of Vitamin B_6 and minimum (63·88 μ) at 1 ppm of 2, 4-D among ten growth regulators. In 3-IAA, 3-IBA, 2, 4-D, PAA, TIBA and Vitamin B_1 the growth rate is rapid in first hour than in the second hour. But growth rates at some concentrations of a-NAA, d, 1-T, Vitamin B_2 and B_6 are less in the first hour than in the second hour. The abnormalities like polysiphony, branching, coiling, crinkling are noticed towards lower concentrations in nine growth regulators except in a-NAA. 3-IAA, PAA, TIBA, a-NAA, d, 1-T, vitamin B_1, B_2 and B_6 have both stimulating and retarding effects on pollen tube growth. But 3-IBA and 2, 4-D have got positive retarding effects. Considering the three species in general, 3-IAA, a-NAA, d, 1-T, Vitamin B_1 and B_2 have stimulating effects but 3-IBA, PAA, 2, 4-D, TIBA and Vitamin B_6 have retarding effects on the growth of pollen tube.

94. The use of 2, 4-dichlorophenoxyacetic acid on the control of some weeds.

B. PANIGRAHI, Berhampur and G. MISRA, Cuttack.

The effect of the synthetic hormone 2, 4-dichlorophenoxyacetic acid (2, 4-D) on the control of two weeds, *Argemone mexicana* L. and *Heliotropium indicum* L. has been studied. Aqueous solution of the chemical at five different concentrations of 1·0%, 0·5%, 0·25%, 0·1% and 0·05% has been used. Both the weeds were highly susceptible to the chemical. Next day after the spray the shoots bent down and the old leaves developed black patches here and there, which soon spread throughout the entire lamina. After the application of the chemical no new leaves were formed, even the young leaves which were in the stage of opening did not unfold and the growth in height of the plants stopped. Further, no new inflorescences appeared nor the existing flower buds bloomed. Hence 2, 4-D not only put a check on the growth of the plants but also set up a retarding process which resulted ultimately in the death of the plants within ten days of the initial application.

Of the several concentrations tried all were equally effective in killing the plants but the lowest concentrations took a longer time. Judging from all aspects 0·5% is considered to be the best concentration for an immediate effect.

95. Studies on Molybdenum deficiency symptoms in some common crops of Gujarat.

G. R. REDDY and B. V. MEHTA, Anand.

Symptoms of Molybdenum deficiency and toxicity have been studied in tobacco, blue panic grass, rice and bean using sand culture technique and applying 0·00005, 0·0001, 0·001, 0·1 and 50 ppm Molybdenum in nutrient solution and a control containing no Molybdenum. Appearance of small necrotic areas, older leaves becoming chlorotic and getting bleached are the symptoms observed in tobacco. In blue panic grass yellowish-green color with brown tips and spots on the entire surface of the leaf are the main symptoms. Slightly interveinal chlorosis in the middle of the upper and middle leaves extending across the width are clearly seen in the Molybdenum-deficient rice plant. In bean the characteristic deficiency symptoms are the large interveinal white scorched areas in the upper leaves.

96. Effect of applied Molybdenum on the growth and chemical composition of some common crops. (Sand culture studies).

G. R. REDDY and B. V. MEHTA, Anand.

Four common crops of Gujarat region were grown in sand culture and supplied with nutrient solutions containing different amounts of Mo. viz. 0·00005, 0·0001, 0·001, 0·1 and 50 ppm with a control containing no Molybdenum. There was a continuous increase in the crude protein and dry matter contents as the level of Mo in the nutrient solution increased from zero to 0·1 ppm. At the toxic level (50 ppm) there was again a reduction. Up to 0·001 ppm the uptake of Mo by plants was correspondingly low. Above this level of supply the content of the leaf rose rapidly. Much accumulation of Copper in Mo. deficient plants and below normal accumulation in plants grown under toxic levels of Mo was observed, showing that there is inverse relationship between Cu and Mo.

97. On the nature of photoperiodicity in summer and winter Rice.

P. K. SEN and G. N. MITRA, Calcutta.

Results of experiments on the effect of 8-hour short-day exposure given at three different stages of growth viz., (i) from time of germination, (ii) from 2 weeks after germination and (iii) from 4 weeks after germination for varying periods, 2 weeks, 4 weeks, 6 weeks and until flowering, on time of flower emergence in two varieties of summer rice, *Charnock* and *Dhairal,* and two varieties of winter rice, *Bhasamanik* and *Patnai-23* are presented.

The two winter varieties of rice have consistently shown hastening of flowering due to short-day treatment without any marked difference, between the varieties, in their nature of photoperiodic response. "Stages of growth" and "periods of exposure" have both indicated to influence the intensity of short-day effect. The critical stage of growth for short-day effect in winter rice is indicated to appear four weeks after germination. The intensity of the effect is indicated to be directly proportional to the length of the period of exposure.

The two summer varieties of rice, however, show characteristic differences in their response to short-day treatment. *Charnock* shows an effect of delaying flower emergence due to short-day treatment irrespective of stage of growth although the intensity of the effect is the less, the later in the stage of growth the treatment is begun. *Dhairal* shows a delaying effect on flower emergence due to short-day treatment when given at the early stage of growth (from time of germination) but an opposite effect, hastening flower emergence, due to short-day treatment when given at later stages of growth.

98. Some observations on the application of the phytohormones, 2-4 D, sodium salt over cane foliage on juice quality.

S. C. SEN, J. P. BANSAL and J. C. BHARGAVA, Kanpur.

A few experiments were conducted both on field and laboratory scale to test the effect of spraying the phytohormone 2-4 D, sodium salt of the concentration 50 p.p.m. at the rate of 10 gallons per acre over the cane foliage. The results obtained were not systematic, rather erratic. At times better juice quality was obtained and again lower values were obtained but the statistical test was non-significant. Further experiments under controlled condition with canes of almost equal brix, selected by Hand Refractometer test also indicated the same trend. A number of experiments need to be repeated for confirmation.

HORTICULTURE

99. Influence of rainfall on the field of Mango.

A. K. GHOSH and P. C. MALLICK, Sabour.

A study was made on the influence of rainfall on the yield of mango. The data comprised of fifteen years' yield collected from the experiments carried out at the Fruit Research Station, Sabour, and the total annual rainfall in inches, recorded at this Station. The rainfall data was divided into four parts (i) Pre-F.B.D. period, during which elongation and cessation of vegetative growth occur, (ii) F.B.D. period, (iii) flowering and fruit-set period and (iv) fruiting period. The association of yield and rainfall was then determined in each case. Regression equations of first and second degrees were also formed.

Although a definite conclusion cannot be arrived at as the data is inadequate, good indications have been obtained from the analysis of the data. Rainfall appears to affect the yield adversely when the precipitation in a particular period is greater than any other period. Abnormal rainfall during pre-F.B.D. period or F.B.D. period or flowering and fruit set period is more harmful. A unifom distribution of rainfall, probably, does not affect the yield. With such data of rainfall and yield, a polynomial of the 2nd degree appears to give better fit than the linear.

100. Effect of fertilizers (N, P, K and Ca.) on growth, flowering and fruiting of Litchi (*L. chinensis*).

P. C. MALLIK, Sabour.

Litchi plants show potash and calcium deficiency symptoms when growing on soils containing less of these two elements. Potash deficiency is marked on the leaves as potash scortch on the lower margins and tips while the Calcium hunger-signs are depicted by necrosis of the middle part of the mid-ribs. Both of them can be rectified by basal application of woodash and lime at 50 lbs. and 20 lbs. per tree respectively.

Nitrogen at single (1 lb. of N_2 per tree) or double (2 lb. of N_2 per tree) dose has got different effect on flowering and fruiting. Flowering is induced and/or enhanced when nitrogen is applied at single level whereas nitrogen at double dose inhibits fruiting to some extent but the plants appear healthier.

During the first year, the effect of Ca at low level (10 lb. per tree) was noticed on fruiting but not on flowering, showing that Calcium helps in fruit set. In other years the effect of Calcium at 2 levels evened out. Calcium should be applied once in 4 years.

Phosphate probably played little or no part at any level during the later years though in the 1st year it showed a little effect on flowering.

The experiments are being continued.

101. Effects of growth substances on rooting of mango layerings.

P. K. SEN and T. BOSE, Calcutta.

Results of an experiment on the effects of Indole acetic acid (IAA), Indole butyric acid (IBA), Naphthelene acetic acid (NAA) and Maleic hydrazide (MH) in three concentrations each viz., 10,000 p.p.m., 5,000 p.p.m. and 1,000 p.p.m. in lanolin on layerings of mango, var. Kohitoor, made by ringing (i) in middle of May (summer) and (ii) in middle of June (rains setting in) applied at two stages, (a) at the time of ringing and (b) after callus formation (20 days after ringing), are presented. IAA, IBA and NAA have indicated definite root promoting effect, the best results having been noted under IBA and NAA in 5,000 p.p.m., the average maximum percentage of layers rooting being 60. June ringing has indicated better results than May ringing. Maleic hydrazide has failed to induce rooting but it induced callus formation markedly.

102. Investigation on the spoilage of Indian preserves.

MIRLE S. SUBBA RAO and D. S. JOHAR, Mysore.

Spoilage organisms, from fermented trade samples of preserves, were isolated and have been identified. The spoilage organisms belong to *Zygosaccharomyces* genus. Only two distinctive species have been found to be the causitive organisms and they are, *Zygosaccharomyces rowxii* and *Zygosaccharomyces mellis*. These two cultures have been used as list organisms in the studies.

Investigations were carried out to determine the effect of combination of sugars like sucrose and glucose etc., and the limiting concentration to prevent the growth. The permitted preservatives were used in permissible concentration, singly and in combination and their efficiency has been determined. The use of acetic acid to prevent fermentation by *Zygosaccharomyces* group in heavy syrups has also been investigated.

In all these experiments, heavy suspension of actively growing culture have been used.

103. Drying bael (*Aegle marmelos*, Correa) pulp in thin films by different methods and properties of the prepared product.

U. P. VERMA and S. AHMAD, Sabour.

Bael pulp is generally utilised for making preserves (morabbas) and sherbats, but when converted into powder, it can be used as a substitute for the sherbat. Bael powder has an advantage of easy packing and transport.

The pulp from well ripened fruit is suitable for dehydration and subsequent conversion into powder.

When it is combined with 30% sugar, the pulp yields a product fit for easy grinding and which retains original flavour and colour considerably, besides, its taste is also improved.

Drying when conducted at the maximum temperature of 120°F the minimum period required will be 15 hours for obtaining the end product possessing desired colour, flavour, taste and stage for pounding into powder of fine texture. Its weight is about a fifth of the pulp from which it is made.

The powder when fortified with vitamin C at the rate of 66 mgms. per 100 gms. is found to retain it without appreciable loss during its 3 months storage period.

SECTION OF PHYSIOLOGY

President:—Dr. S. N. Ray, Ph.D.

Abstracts

BLOOD

1. Pyridine Nucleotides during Haemopoisis.

SHARAD G. JOSHI and S. K. GOKHALE, Bombay.

It has been shown by earlier workers that Pyridine nucleotides (PN) undergo changes in liver and blood in fatty infiltration of liver and blood PN levels are an index of liver PN stores. During the course of our investigations on the PN metabolism in hepatospleenomegaly, higher values for blood PN were obtained. Since the liver disease is often associated with anaemia, it was thought desirable to study blood PN levels in isolated anaemia cases without severe liver dysfunction.

Data has been presented for normal blood PN levels per ml. blood and per ml. R.B.C. for seventy-five healthy Indian male subjects. Untreated cases of anaemia (35 hypochromic and 8 hyperchromic) showed elavated blood PN levels while the anaemia, previously partly treated (8 cases) with B complex or iron therapy, showed subnormal levels, suggesting the relationship of B complex and iron to blood PN levels. Eight cases of vitamin B_{12} deficiency and ten cases of iron deficiency anaemia were followed at weekly intervals for the changes in blood PN levels during haemopoisis. It was observed that vitamin B_{12} and iron depressed the PN to subnormal levels which further tended to return to normal during progressive haemopoisis. Retarded haemopoisis was, however, found to be accompanied by an increase in the PN levels. The possible correlation of the blood PN levels with haemopoisis is discussed.

2. The production of a Leucopenia in Albino Rats using the Phosphomolybdic-Folic Acid Complex.

P. P. NAIR and N. G. MAGAR, Bombay.

The crystalline phosphomolybdic-folic acid complex, was administered to adult albino rats parenterally at a level of 10 mgs./kg. bodyweight. The total leucocyte and differential leucocyte count of the experimental animals were determined previous to the administration of the complex and repeated 48 and 96 hours after it. A second dose of the complex was given in the second week and observations on total leucocyte and differential leucocyte repeated. Results indicated a rise in the neutrophil count, accompanied by a lowering of total leucocytic count. The development of a leucopenia by means of this substance, derived from folic acid is interesting in that it resembles in action to the folic acid antagonists, such as aminopterin and methopterin and considered to be effective tools for inducing remissions in the acute leukemias.

3. The Effect of Injection of Adrenal Cortical Extract on Haematological Changes in Scurvy.

CHANDICHARAN DEB and SACHCHIDANANDA BANERJEE, Calcutta.

It has been shown earlier that there is a decrease in R. B. C., haemoglobin and cell volume in scorbutic guinea pigs; the number of reticulocytes on the contrary showed an increase (Deb and Banerjee, 1953). Studies were undertaken to observe if injection of adrenal cortical extract has any benificial effect on the haematological changes.

Injection of adrenal cortical extract to scorbutic animals cause a rise in the number of R. B. C. which however is less than normal. The haemoglobin concentration which is reduced in scurvy does not improve after the injection of cortical extract. The higher reticulocyte count of scorbutic animals further increases after the injection. It may be possible that injection of adrenal cortical extract stimulates formation of blood cells, but in the absence of vitamin C iron can not be utilized to form haemoglobin.

4. Estimation of Plasma and blood volume in the buffaloes using 'T-1824' hemotocrit method.

T. L. MURTY and D. N. MULLICK, Izatnagar.

82 buffaloes, consisting of 25 calves (1-2 years), 26 and 31 adult male and female buffaloes were used to measure the plasma and blood volume by "T-1824" hematocrit method.

The amount of dye, 'T-1824' injected to each animal was 0·3 mg./kg body weight. After injection the blood samples were collected at the interval of 10 minutes for one hour. The concentration of the dye is measured in photo-electric colorimeter by using the dye free plasma as blank. The results indicated that the plasma volumes in ml. per kg. live weight were 41·4±0·88, 35·4±0·75 and 36·2±0·65 for calves, male and female buffaloes respectively. The corresponding blood volume in ml per kg. live weight were 57·6±1·12, 51.5±1·04 and 52·9±0·80. The figures for correlation coefficients between live weight and plasma and blood volumes are all highly significant. The relation between the volumes and the live weight can be fitted in regression lines. The blood and plasma volume gradually declined with the increase in age whereas within the sex the difference is not significant. A comparison has been made between the present figures with the figures of other domestic animals like cows, dogs, rats and rabbits.

5. Hexosamine content of blood in hypervitaminosis A.

AMAL RAY and D. P. SADHU, Calcutta.

Rats fed 30,000 units of vitamin A daily for 10 days usually suffer from a bleeding tendency which may at least be partly due to hyperheparinemia. Since one of the constituents of heparin is glucosamine, the glucosamine content of blood serum and of liver tissue was estimated by the method of Elson and Morgan. It was expected that there would be probably an increased concentration of glucosamine to cause hyperheparinemia but actually there is a decrease in the hexosamine content of the serum, being 185±2·1 mg. per 100 ml. serum in rats made hypervitaminotic A compared to the control rat serum with 243±1·7 mg. per 100 ml. serum. This may be, however, due to an intracellular transfer of hexosamine to blood or an increased utilisation of the amine in the synthesis of heparin.

6. Mode of action of Venon of Vipera Russelli in the coagulation process of blood.

B. B. NATH, Calcutta.

Russell's viper (Vipera Russelli) venom possesses a strong thromboplastin-like property in the coagulation process, although there is some structcural difference between the two. The U. V. absorption curves are different; only the venom solution shows a maximum at 277·5 mμ. Oxalated, citrated or decalcified (using Na form of Amberlite IR-120) plasma clot, though imperfectly with venom alone, due to small amount of calcium ion present in those plasma;—this being slowly made available for reaction. The proteolytic activity of the venom—more pronounced at higher concentration—proceed side by side with the clotting process which, of course, proceeds faster. Heating at 75°C for 30 minutes brings about the destruction of most of the enzymetic activity of the venom and small portion of it, which remains, is insufficient to show any proteolytic activity, but can record its clotting activity in presence of calcium ion.

An apparent stoichiometric relation can be observed by varying the proportions of calcium ion and the venom. The inhibitory effect of excess of calcium ion can even be overcome by using excess quantity of venom which normally possesses marked proteolytic effect; when the two inhibitory effects counteract each other. Considering the equilibrium conditions in trace protein reactions, combining proportions between calcium and venom are not suggested. In all probability, Ca ions have got stabilising effects over the clot which ordinarily can be digested in presence of a high concentration of the venom.

HEART AND CIRCULATION

7. "The effects of increase in the Right Auricular Pressure due to Intravenous infusions on Intact Dog Hearts : A New approach to the interpretation of Bainbridge's observations.

C. L. PATHAK, Jaipur.

The results of 108 infusion experiments on the chronotropic response of dog hearts indicate that a rise in the intra-auricular pressure as a result of intravenous infusions was associated with either a positive or a negative chronotropic effect or with a no chronotropic effect both in the closed and open chest experiments. A correlation was observed between intro-auricular pressure and heart rate in some hearts upto a critical pressure. Bilateral vagotomy topical application of cocaine or parenteral administration of atropine, tetraammonium or hexamethonium sufficient to paralyse autonomic activity did not influence the development of these chronotropic effects. There is no justification for labelling the influsion acceleration response, observed in some infusions as a reflex effect. The chronotropic effects accompanying infusions, develop in the heart itself and presumably depend upon the initial conditions at the pacemaker.

8. "The effect of changes in the Intraluminal pressure stretch on the inotropic and chronotropic responses of the Isolated Perfused Mammalian Chole Heart and Right Auricles."

C. L. PATHAK, M.D., Jaipur.

The study of the effect of stretch on the inotropic and chronotropic responses of amphibion hearts have been extended to mammalian hearts. The effect of increasing the intraluminal pressure, in the right heart on the activity of the isolated perfused whole dog hearts and the effect of increasing the intraluminal pressure on the activity of the isolated right auricles of dogs, rabbits, guinea pigs and albino rats have been studied. It has been observed that there is an almost direct relationship between the magnitude of intraluminal right auricular pressure and the inotropic and chronotropic responses of the right auricles and whole heart up to certain critical heads of pressure (5 to 15 mm. Hg.). Some important adaptive modifications in this behaviour of the hearts to repeated changes in the intraluminal pressure have also been described. · It has been suggested that stretch of the pacemaker tissue and the muscle fibers due to increased intraluminal pressure may cause alternations in membrance metabolism.

9. "Mean auricular flutter rate of dogs under Sodium Pentobarbitone anaesthesia."

R. B. ARORA and P. L. SHARMA, New Delhi.

Data have been collected on the mean auricular flutter rate of 200 mongrel dogs, under Pentobarbitone anaesthesia during the period July 1955 to August 1957. Auricular flutter was produced by the Injury-Stimulation method of Rosenbleuth and Garcia Ramos (1947). The mean auricular flutter rate in the total group was 477·20/mt., the range being from 340 to 640/mt. A co-relation exists between sex, weight, season of the year, rectal temperature and the mean auricular flutter rates. The males had a higher mean auricular flutter rate than females. In the total group the highest mean auricular flutter rates were found in the 12·5–7·4 Kgm. weight group, in the 28·1 to 39°C range of rectal temperature; while the lowest values were observed in the 2·4-7·5 Kgm. weight group, in the 36-37°C range of rectal temperature. A decrease in the mean auricular flutter rate was observed in colder months. 2:1 auriculo-ventricular response was the commonest occurrence in our experiments.

10. "Choice of Narcotics in the Study of Circulatory, Respiratory and Gastro-intestinal Functions in Animals."

B. S. KAHALI and M. L. GUPTA, Jaipur.

Effects of distention of duodenum and rectum on circulation, respiration and gastrointestinal motility and secretion have been studied under commonly used narcotics-chloralose, nembutal and urethane in dogs.

The usual recommended dose of chloralose (80–100 mg./Kg.) and nembutal (40–50 mg./Kg.) is scarcely tolerated by the local breed of dogs. A diminution of 25% in the recommended dose ensures a better preparation.

The reflex effects on circulation, respiration and gastro-intestinal functions are better shown under chloralose than under nembutal. Nembutal is a depressant to most spinal and madullary reflexes, but has been found more suitable for experimental surgery.

The anaesthetic dose of urethan causes great depression of respiration and circulation but gut motility is very well shown. The reflex effects are however depressed in most of the cases.

11. "Cardiac Acceleration in Frogs on Vagal Stimulation."

B. S. KAHALI and S. N. GUPTA, Jaipur.

Presence of cardiac inhibitory and accelerator fibres in Vagi in frog is known.

Stimulation of Right or Left or both vagi causes cardiac partial or complete inhibition in most cases. In some cases in winter cardiac acceleration was obtained. In these cases none of the vagi gave inhibitory response and also in such cases even stimulation of the cresentic line gave the same accelerator effect and inhibition was not present.

It is suggested that during the winter months in this cold blooded hibernating animals acetylcholine the vagal humoural agent is not formed.

RESPIRATION

12. Ventilatory Function Studies in male adults.*

H. D. SINGH and S. PRABHAKARAN, Madras.

Employing a Collin's Respirometer, Vital Capacity (V.C.), Timed Vital Capacity (T.V.C.), and Maximum Breathing Capacity (M.B.C.) were determined in 163 healthy male subjects between 17 and 62 years. Various physical measurements of the subjects (Height, weight, B.S.A., Chest circumference and diameters) were also recorded. The mean values, with the ranges and S. D. for the age groups 17-39 years were given in a preliminary note. In this report, further data for the higher age group, and the results of statistical correlation of function values with physical measurements are presented.

Both V. C. and M. B. C. were significantly related to B. S. A. and to height, the regressions being

V. C. in cc. $= 151 + 2145 \times$ B. S. A. in sq. m. and $-3010 + 40{\cdot}39 \times$ Ht. in cms.

M B. C. in Litres/min. $= 65{\cdot}2 + 58{\cdot}53 \times$ B. S. A. in sq. m. and $-18{\cdot}9 + 1{\cdot}086 \times$ Ht. in cms.

A significant relation between M. B. C. and 2 sec. T. V. C. was observed, and the regression formula M. B .C. in L/min $= 83{\cdot}6 + 21{\cdot}9 \times 2$ sec. T. V. C. in Litres, may be usefully employed to predict M. B. C. from T. V. C. in patients who are too ill to perform to more exhausting M. B. C. test.

13. "Circulatory and respiratory responses to duodenal distention."

B. S. KAHALI and M. L. GUPTA, Jaipur.

The effect of distention of duodenum of healthy street dogs anaesthatized with suitable fixed dose of chloralose with various pressures on circulatory and respiratory functions have been studied.

Distention of duodenum causes slowing of respiration with increase in depth and prolongation of inspiration. The tidal volume is increased but the pulmonary ventilation per minute is diminished. Such distention also causes slowing of heart with rise of blood pressure, possibly due to increased peripheral resistance. The circulatory and respiratory effects to distention persists without any decrement as long as the distention is maintained.

From these results it has been concluded that there are stretch receptors in the region of the duodenum with reflex effect on respiration and circulation. Like most stretch receptors they do not show adaptation.

NERVOUS SYSTEM

14. Variability of the gastric secretory response of normal persons to alcohol test meal and Histamine injection.

B. S. KAHALI, Jaipur.

Secretory response of the human stomach to test stimuli of (1) alcohol meal and (2) histamine given subcutaneously has been investigated by repeated fractional gastric analysis on ten healthy subjects. In five subjects the tests were repeated six times on each with alcohol meal in others it was repeated three times. For the Histamine test four of these subjects were selected and factional gastric analysis was done on these five times on each subject.

The secretory response of the stomach to these test stimuli vary considerably from day to day: the same subject may be hypochlorhydric on the first day hyperchlohydric next day and isochlorhydric on the third day.

As a method of estimating gastric secretory function a single fractional gastric analysis is of no value.

15. "Improved methods of studying gastrointestinal movements in animals."

B. S. KAHALI and M. L. GUPTA, Jaipur.

The use of balloons for recording gut motility is unsatisfactory for several reasons. The constant efforts of the bowel to get rid of them often overshadow the effects of any other stimuli that one may be trying to record. Various methods of recording gut movements have been tried in healthy dogs anaesthetised with suitable fixed dose narcotics.

Two of the six methods for recording gut movement tried in this work have been found superior to the others. The technique suggested for recording gastrointestinal motility with Cushny's myocardiograph, gives satisfactory results. For recording the movements of the gut, where Cushny's myocardiograph technique is not possible, an improved balloon technique has been described. In this the contraction of the bowel forces water from the balloon into the reservoir in precisely the same fashion as they would force the contents of the bowel into the adjoining segment.

16. "The influence of rectal distention on gastrointestinal motility and secretion."

B. S. KAHALI and M. L. GUPTA, Jaipur.

The presence of stretch receptors in the rectum and their effects on circulatory and respiratory functions have been reported by us elsewhere. The influence of these receptors on gastrointestinal motility and secretion has been studied on healthy dogs anaesthetised with suitable fixed dose of chloralose or morphine urethan.

The distention of rectum depresses gastric, duodenal, jejunal and ileal secretion; while rectum gives a slight mucous secretion. Caecum is however irresponsive. The distention also causes increased gastric, duodenal, jejunal, ileal, ceacel and transverse colon mobility. The motor and secretory responses are better marked under 20 and 40 than 10 mm. Hg. pressure.

The motor effects are persumably intermediated by nervous mechanism through reflex paths as they cease with cessation of distention. The depressing effect on secretion however persists after the discontinuation of the distending stimulus.

This persistance of depression is suggestive of hormonal mechanism by itself or in addition to the nervous mechanism. It is suggested that distention of rectum and colon, in constipation, causes inhibition of secretory activity affecting digestion.

17. "The effects of duodenal distention on gastrointestinal motility and secretion."

B. S. KAHALI and M. L. GUPTA, Jaipur.

The presence of stretch receptors in the duodenal region and their reflex effects on circulation and respiration have been reported by us elsewhere. The influence of these receptors on gastrointestinal motility and secretion has been studied on healthy street dogs anaesthetised with suitable fixed dose of chloralose or morphine urethan.

The distention of duodenum causes increased tone and rhythmicity of jejunum, ileum, ceacum, appendix and rectum; ascending colon is however irresponsive to such distention. The stomach is inhibited. The distention of duodenum causes increased duodenal and jejunal secretion while the effect on gastric secretion is variable. The secretory activity of the rest of the gut is not affected. The motor and secretory responses are better marked under 20 and 40 than 10 mm. Hg. pressure. When the distention stimulus is discontinued, the motor effects disappear but the secretory effects continue which suggest that the motor effects are due entirely to nervous machanism while the secretory may be due to nervous, humoral or dual mechanisms.

18. Physiological connections between the cerebellum and the limbic system.

B. K ANAND, C. L. MALHOTRA and BALDEV SINGH, New Delhi.

Cerebellum has been divided into neocerebellum consisting of most of the lateral cerebellar hemispheres and some portions of Vermis, and paleocerebellum consisting of mainly the remaining anterior and posterior portions of vermis. Previous studies have established interconnections between the neocerebellum and neocortex. The anterior and posterior regions of paleocerebellum, on the other hand, have been shown to project only to reticular formation (brain stem), the flocculonodular lobe being connected only to the vestibular nuclei. In the present study, in 50 dogs, Vermis regions of the cerebellum were stimulated, and the potentials so evoked recored from different regions of the limbic system in the following pattern.

(1) *Flocculonodular lobes* :— Heavy projections were mapped out form this to the orbital surface of the frontal lobes, and amygdaloid—periamygdaloid- -hippocampus complex of the temporal lobes. Some potentials were also evoked in the anterior cingulate and certain hypothalamic regions. No potentials evoked in the neocortex.

(2) *Posterior paleocerebellum* (Pyramis, and Uvula) :— were found to project to the same limbic regions as (1), but the projections are not heavy.

(3) *Anterior paleocerebellum* (Lingula, Centralis, Culmen, and Simplex) :-- Some potentials evoked in the orbital surface and some temporal structures.

(4) *Neocerebellar regions of Vermis* (Declive and Tuber) :— Only occasional potentials evoked in amygdaloid regions.

This study establishes physiological connections between paleocerebellum and limbic system, probably through the reticular formation (activating system of

Magoun—Centrencephalic centre of Penfield), and in view of the recent work suggesting the involvement of limbic regions in the conscious response, is of much added interest.

19. Hypothalamic control over water consumption in the rat.

B. K. ANAND and S. DUA, New Delhi.

The role of hypothalamus in regulation of food intake has been long recognised. The influence of this region of the brain over water intake has also been reported. An attempt is made in this study to localize the various hypathalamic regions responsible for the changes in the water intake.

Daily water and food intake was recorded in 30 albino rats, both before and after bilateral lesions in different hypothalamic regions, placed with the help of the Horsley Clarke stereotaxic instrument. The variations produced as a result of lesions were compared with pre-operative values which were taken as controls. It was observed that after lesions in the lateral hypothalamic region ("feeding centre") complete adipsia was produced alongwith aphagia. On the other hand after lesions about 1 mm. removed from the "feeding centre", the water intake significantly decreased, inspite of the fact whether there was any change in food intake or not. After lesions further removed from this region, there was no significant change in water intake, inspite of changes in food intake. Thus the hypothalamic region controlling food intake ("feeding centre") and its surrounding regions, also constitute a neural mechanism responsible for thirst and its alleviation.

20. Effects of frontal and temporal lobe lesions on the affective Behaviour and visceral responses in cats and monkeys.

B. K. ANAND and G. S. CHHINA, New Delhi.

The effects of extensive temporal and frontal lobe lesions on affective behaviour and visceral activities were reported last year. These studies were further extended by producing small surgical lesions restricted to small areas of frontal and temporal limbic structures in 22 monkeys and 10 cats. The following results were observed :—

I : *Affective Behaviour* :—

(a) *Temporal Lobe Lesions* :—It was previously reported that after extensive lesions the animals become fearless, non-aggressive, calm, docile, develop visual agnosia, oral tendencies, and lack of localisation in space and localisation of sound. After restricted lesions the animals were generally fearful. Lesions in temporal tip and hippocampus resulted in hypersexuality in the male operates. One animal with the involvement of insula and hippocampus developed disturbance of taste. The Oral tendencies, hypermetamorphosis, and non-avoidance of noxious stimuli was more marked and persisted for a longer time.

(b) *Frontal Lobe Lesions* :—In contrast to our previous results of extensive lesions of this area which produced confusion, shyness, fearlessness and agnosia, mental deficit was much less with restricted lesions and the responses varied from animal to animal. It is confirmed that hyperkinesis is a result of caudate head damage, rather than involvement of orbital cortex.

II :—*Visceral Activities* :—

(a) *Circulatory Changes* :—There was a tendency for blood pressure to fall with a rise in heart rate after frontal lobe lesions. But the results after restricted temporal lobe lesions were quite variable.

(b) *Respiration* :—Generally fall in the rate of respiration was noticed after both frontal and temporal lobe lesions.

(c) *Gastro-Intestinal Tract* :—Showed hyperaemic and ulcerative changes in the mucosa. Five monkeys after hippocampus lesions had ballooning of the gut.

MUSCULAR SYSTEM

21. Electromyographic studies on the functional relationship between some postural muscles.

N. N. DAS and A. K. GOSWAMI, Calcutta.

Electromyographic studies on the functional correlation between different postural muscles during different postural alignments of the body were made. Electrical activities of various muscles, such as the sacrospinalis, rectus abdominis, external and internal obliques, serretus anterior, deltoid, gastrocnenius, soleus and the hamstrings were studied. Susceptibility and degree of onset of fatigue in these muscles depend on the exact postural alignment. Correct alignments in which the activities of the muscles are minimal and the weight of the body is borne by the bones and joints, have been found out for individual postures for standing and sitting down.

22. Mechanical responses of striated and cardiac muscle in sodium-free solution.

BHATT J. V., Bombay.

Singh and Bhatt have shown that frog's stomach muscle maintains its excitability in half tonic sucrose solution for as long as 24 hours. They also showed that the muscle shows an increase in excitability in this solution. In the present work an attempt has been made to study the behaviour of skeletal and heart muscle in this solution. It was found that frog's sartorius muscle becomes inexcitable by the end of two hours. Frog's heart when perfused with this solution gradually loses its spontaneous contractions with simultaneous establishment of heart-block. Ventricle stops beating in about 10 minutes but auricle continues to beat for about two hours.

23. Effect of ions on stretched striated muscle.

B. B. GHOSH, S. P. BHATNAGAR & D. P. SADHU, Calcutta.

There are differences in the effect of ions on the isotonic and isometric contractions of striated muscle. On stretching of muscle, there is lengthening of the fibres which tends to cause increased alkalinity and other changes. In the present experiments there are two series. In series I toad gastrocnemins has been stretched 10% of its initial length with 50 gm load and the effect of different concentrations of sodium, potassium and calcium has been studied on the maximum tension in the muscle produced by electrical stimulation and compared with the other of the pair of the gastrocnemius muscles kept in unstretched condition. In series II, the toad sartorius has been stretched to 120, 125 and 130% of initial body length and the maximum tensions in these stretched muscles in different concentrations of sodium, potassium, calcium and magnesium have been compared with that in the twin gastrocnemius placed in amphibian Ringer,

24. Influence of temperature on the active relaxation of unstriated muscle produced by urea.

SUNITA INDERJIT SINGH, New Delhi.

Some unstriated muscles relax actively. Agents, both physical and chemical, which denature proteins, also cause active relaxation of a unstriated muscle. Denaturation consists of an alteration of the specific internal structure of the protein wherein the closely folded chains unfold. Contraction of the muscle is considered to be due to folding of the contractile protein ; so relaxation would be due to unfolding of the muscle proteins. The process of relaxation of muscle would therefore be similar to the denaturation of proteins. Thus agencies, which denature proteins cause unstriated muscle to relax actively.

Urea is a well known reagent which causes denaturation of proteins. It causes marked active relaxation of unstriated muscle, presumably after rupture of hydrogen bonds which hold the polypeptide chains in a folded state causing tonic contraction of the muscle. Though the effect of urea in causing active relaxation has been studied, no experiments have been performed to note the influence of temperature on such effect. In the present research, therefore, experiments have been conducted to study the effect of variation of temperature on the active relaxation produced by urea.

It has been found that variations of temperature from 0 to 45°C. have no significant effect on the active relaxation of frog's stomach muscle by urea. The active relaxation by urea at temperature from 50°C. to 75°C., is less than at temperature from 0 to 45°C. The muscle from the pyloric end relaxes less in urea than that from the cardioc end. It thus resembles heated muscle. Heat produces coagulative changes, which are accompanied by the development of cross linkages between the folded polypeptide chains. It is concluded, therefore, that tone in unstriated muscle, maintained without the expenditure of energy, is due to stabilisation of the folded polypeptide chains by the development of cross linkages.

BIOCHEMISTRY

25. "Observations on the Gastric Analysis of Medical Students of Bihar."

B. B. P. ROY and T. C. GUPTA, Darbhanga.

Fractional Gastric Analysis with Barley meal was done on 96 healthy medical students of the age between 17½ to 25 years hailing from different parts of Bihar. The results have been classified under various heads and have been compared with those of the other workers of this country. Attempts have also been made to account for any differences noted.

Fasting Juice :—

The mean average amount was 27·4—16 cc., range being 4 to 101 cc.

Freshly regurgitated bile was present in 31·9%.

Subsequent Samples :—

Highest acidity reached during the range period of ¾ to 2¼ hours, mean average being 1¼ hours.

The mean average free acidity was 24·5—17·4 units, range being 0 to 64 units.

The mean average highest free acidity was 35·4—16·9 units.

According to Napier's classification 2·3% of the persons were Achlorhydric, 3·5% Hypochlorhydric, 90·7% Isochlorhydric and 3.5% were Hyperchlorhydric. Among the Isochlorhydric 23·3% were on the low, 43% on the average and 24·4% on the high side of normality.

Significant differences have been noted in the results between males and females but not with diet or religion.

In 47·2% of cases stomach emptied by the end of 2¼ hours the minimum time being 1¾ hours.

26. Study of Urea Clearance Test in Normals.

M. L. PAI, Boroda.

Eighteen normal male healthy subjects of age varying between 17 and 22 years have been studied for their blood urea clearance test. The standard clearance in seven of these subjects varied between 28·3 and 62·1 cc. with an average value of 43·3 cc; whereas the maximum clearance in the remaining eleven subjects ranged from 27·6 to 74·0 cc. with the mean value of 54·3 cc. In these subjects the urinary urea varied from 117 to 1575 mg% with an average value of 584 mg.%; whereas the blood urea ranged from 20 to 36 mg.% with the mean value of 26·4 mg.%. Both the standard urea clearance and the maximum urea clearance thus seem to be lower : in normal Indians, as compared with the corresponding values in Westerners. The fact that the blood urea is more or less the same in both Indians and Westerners, whereas the urinary urea is lower in Indians than in Westerners, which may be due to different vegetarian composition of Indian dietaries may be the responsible factor for their lower urea clearance. The significance of the above findings has been discussed in the paper.

27. A study on factors present in Proteolysed Liver Extract.

A. N. Bose, Calcutta.

The growth-stimulating activity of different batches of proteolysed liver extract, both before and after alkaline hydrolysis, has been studied on two assay organisms, *Escherichia coli*, 301 (mutant) and *Lactobacillus leichmannii*, 313, by following the agar-cup method of assay. The results suggest that, apart from alkali-labile growth factors, like vitamin B_{12} or its derivatives, proteolysed liver extract contains several alkali-stable factors, of which three are definitely suggestive. These are (1) a common alkali-stable factor acting similar to Vitamin B_{12}; (2) an "inhibitory factor" partially antagonising the activity of Vitamin B_{12} on *E. coli* growth ; and (3) a "bound" form of alkali-stable factor, which is inactive but active after alkaline hydrolysis of the proteolysed liver extract.

The factors (1) and (2) are slow-moving components in chromatography like vitamin B_{12}, while the factor (3) appears to be a fast moving component.

28. Effect of concentration of Setyltrimethyl Ammonium Bromide on the solubility of Protein.

S. K. DUTTA, Calcutta.

Use of cetyltrimethyl ammonium bromide (Cetrimide) for the precipitation of protein (free or conjugated) has been previously reported (Dutta, *Ind. J. Pharm.*, 18, 47, 219, 1956). It was noted that for optimum precipitation the amount of the cetrimide had a distinct and sharp relation with the amount of the protein present in the solution. This relation has been demonstrated in this report. It has also been shown that any excess of the cetrimide might redissolve the precipitated protein. This solubilizing ability of the cetrimide has been demonstrated with a sample of chloroform-denatured protein. Finally it has been observed that cetrimide at different concentration might fractionate a protein, as evident from the paper ionophoretic analysis of the different precipitates of proteins obtained with various concentration of cetrimide. These properties of cetrimide has been discussed.

29. "On the problem of Standardisation of Liver Preparation : Part II. (Isolation and estimation of choline by a physico-chemical method).

S. K. DUTTA & SRIPATI BOSE, Calcutta.

Estimation of histamine, tyramine, tryptamine and some basic polypeptide in liver preparations by some physico-chemical methods have been previously reported (Dutta and Bose, Ind. J. Med. Res. *in press*) from this laboratory (Bengal Immunity Research Institute). Now another physico-chemical method for the isolation and estimation of choline in liver preparations have been developed in this laboratory. The choline was separated from the macro-molecular bodies as well as the electronegative bodies after electrodialysis. These separated electro positive micro-bodies, containing the choline, were further fractionated on an ion-exchange resin, Zeo-carb 226. The eluate of the resin, containing choline with few other basic bodies, was then precipitated with ammonium reineckate at pH 8·5, when only the choline-reineckate was precipitated. This precipitate was washed and dissolved in acetone for spectrophotometric estimation. The choline was also obtained as free base from the reineckate salt being a resin, Descidite FF. The free base was found to have both nicotine and muscarine action on cats blood pressure. The method was found to be simple and accurate.

30. Enzymatic formation of glucose-cyclo-acetoacetate and biosynthesis of ascorbic acid in Germinating Legumes.

M. C. NATH & M. L. BELKHODE, Nagpur.

The rate of biosynthesis of ascorbic acid in germinating green gram is faster from 24 to 48 hours of germination and the amount of combined glucose has been found highest after 48 hours of germination. Addition of acetoacetate or aceto-acetate and glucose has been found to cause the formation of much more combined glucose, the quantity of free glucose being very low at this period. Condensation product of glucose and acetoacetate (glucose-cyclo-acetoacetate) has previously been reported to be a precursor of ascorbic-acid. The possibility of enzymatic condensation of glucose with acetoacetate during the process of germination has been envisaged in this paper.

31. Acetoacetate induced dehydroascorbic acid accumulation in blood and tissues and its prevention by glucose-cycloacetoacetate.

M. C. NATH and R. M. BEHKI, Nagpur.

The effect of acetoacetate injections in doses of 500 mg/kg on ascorbic and dehydroascorbic acid contents of blood and tissues and their excretion in urine, was studied. Animals injected with acetoacetate excrete more dehydroascorbic acid and less ascorbic acid. Their tissues (liver, kidney, spleen and adrenal) also accumulated more dehydroascorbic acid and the amount of ascorbic acid in them was diminished. Glucose-cyclo-acetoacetate or its hydrolysed product has been found to prevent this increased accumulation of dehydroascorbic acid in blood and tissues. Acetoacetate has been shown to cause oxidation of ascorbic acid to dehydroascorbic acid in vitro in presence of a few drops of $CuSO_4$ solution at a faster rate than that in the control. The mechanism for the prevention of acetoacetate induced accumulation of dehydroascorbic acid by hydrolysed glucose-cyclo-acetoacetate has been suggested.

32. Studies on dietetic liver necrosis and the protection by glucose-cyclo-acetoacetate.

M. C. NATH, A. RAMAIAH, & K. N. Acharya, Nagpur.

The effect of condensation product of glucose and acetoacetate or glucose-cyclo-acetoacetate and its hydrolysed product has been observed in the liver of rats made necrotic by necrogenic diet Reduced glutathione and ascorbic acid levels, which are usually low in necrotic livers were found to be more or less normal when the hydrolysed product of condensation product of glucose and acetoacetate was fed. The unhydrolysed product, when ingested has a little effect on these constituents.

33. Effect of glucose-cyclo-Acetoacetate on the prevention of ascorbic acid depletion in the tissues of scorbutic Guineapigs.

R. M. BEHKI, D. B. MOTLAG & M. C. NATH, Nagpur.

The effect of the condensation product of glucose and acetoacetate on ascorbic and dehydroascorbic acid levels of scorbutic guineapigs and its excretion in urine was studied. The scorbutic guineapigs excreted progressively less of ascorbic acid than those getting condensation product though dehydroascorbic acid excretion did not show much variations in the two groups. The excretion of 17-ketosteroids, increased progressively in all the groups indicating no effect of condensation product in ameliorating the hyperfunctioning of adrenal cortex. But strangely enough, the free and total cholesterol values of adrenals did show a considerable increase on the injection of condensation product to scorbutic animals. Also the GSH content of blood of scorbutic animals was less than the ones getting condensation product through blood cholesterol values were not affected much. Finally the various tissues showed a significant increase in ascorbic acid and slight decrease in dehydroascorbic acid contents of scorbutic animals getting condensation product as compared with the animals kept only on scorbutic diet.

34. Effect of acetoacetate on reduced glutathione and dehydroascorbic acid of the tissues of scorbutic guineapigs.

R. M. BEHKI, M. RAZDAN & M. C. NATH, Nagpur.

Intraperitoneal injection of acetoacetate to the scorbutic guineapigs has been found to decrease the ascorbic content of the tissues further. Dehydroascorbic acid which is practically absent in normal tissues has been found to be present in tht tissues of experimental animals. The GSH content of the tissues of normal as well as scorbutic animals has been found to diminish as a result of acetoacetate injection. The mechanism by which acetoacetate causes depletion of blood GSH and gradual development of experimental diabetes has been discussed.

35. Effect of a single dose of urethan on the alkaline phosphatase of tissues of rats.

BHUBON MOHAN ROICHAUDHURI & SUSHIL RANJAN MOITRA, Calcutta.

Urethan, a member of the carbamate compound series, affects the cellular system both physically and chemically causing a profound change in the molecular pattern of the intracellular heterogenous texture.

Histochemical investigations on the alkaline phosphatase of tissues show that urethan increases the reaction of the tubular epithelia of kidney and also the reaction of spleen. But the reactions of liver, duodenum, suprarenal, testis, ovary and thyroid are depressed as a result of urethan administration.

36. Succinate and acetate oxidation in tissue slices in rat and toad.

D. P. SADHU, Calcutta.

The rats and toads show a marked difference when these are exposed to a low ambient temperature, the former raising their body metabolism to maintain homeothermy, while the latter lowering their body temperature proportionate to the lowered ambient temperature. Since this difference might be partly due to the differences in the enzyme activity in tissues, the Qo_2 value of liver and kidney slices in rat and toad has been determined, with 0·08 M succinate 0·08 M acetate substrate or without substrate and the value compared in the two species of animals under investigation.

37. Amino acid contents of Albezia Lebek and Prosopis Julifera seeds.

JYOTIRINDRA DATTA & KSHIROD R. BHATTACHARYA, Calcutta.

Amino acid contents of the seeds of the desert plants, *A. Lebek* and *P. julifera*, were quantitatively analysed by conventional paper partition chromatography to ascertain the nutritive value of their proteins in relation to their use as fodder. The seeds have been found to be very rich in protein (about 43% on dry and fat-free basis) and contain all the 'essential' amino acids except methionine in high amounts. Methionine content is comparatively low (about 0·7%). All the commonly occurring 'nonessential' amino acids are also present. *A. lebek* moreover contains an unknown ninhydrin-reactive substance.

It is suggested that inspite of the comparatively low methionine content, the seeds have fairly high nutritive value as sources of nitrogen because of their rich protein content.

38. A comparative study of Fructose utilization by Buffalo-Bull Spermatozoa in Citrate and Phosphate buffers.

K. PAL & G. C. BARUA, I.V.R.I., Izatnagar.

Fructose utilization of buffalo-bull spermatozona in semen buffered with M/15 sodium citrate solution was compared with that in semen buffered with a mixture of M/15 primary (KH_2PO_4) and secondary (Na_2HPO_4) phosphates. The pH of both the buffers were adjusted to 6·8 and the samples were incubated at 37°C for 2 hours.

Such comparisons were made for the first and second ejaculates separately.

In all 300 semen samples were studied comprising of 150 first and an equal number of second ejaculates collected from ten healthy Murah buffalo-bulls of approximately six to seven years of age.

It has been found that fructose utilization in both the first and second ejaculates was significantly higher when incubated in citrate buffer in comparisin to that in phosphates. This increased fructose consumption in citrate was found to be significant at 2% and 1% levels for the first and second ejaculates respectively.

The superior preserving capacity of citrate buffer was also confirmed by repeated microscopic examinations of semen samples extended by both egg-yolk citrate and egg-yolk phosphate preserved for 48 hours.

NUTRITION AND METABOLISM

39. Lipid depleted adrenal cortex in molybdenum fed rats and its prevention by vitamin E.

P. P. NAIR & N. G. MAGAR, Bombay-1.

Molybdenum as sod. molybdate was administered to young albino rats in the diet at a level of 100 ppm. To another group of similarly maintained animals, a further supplementation with vitamin E was made. After an experimental period of six months the animals were sacrificed by cardiac puncture and suprarenals processed and sections 5μthick prepared. They were examined under high power in the region bordering the inner zona faciculata and outer zona reticularis. The slides from the control group showed normal histological appearance with normal lipid pattern. The adrenais of molybdenum treated animals showed necrosis and lipid depletion. Those adrenals from experimental animals receiving both molybdenum and vitamin E showed a normal pattern, thus indicating that vitamin E prevents the histological picture produced by molybdenum.

40. Studies on the anti-diuretic action of protein hydrolysate.

A. N. BOSE & A. ROY, Calcutta.

It was observed from this laboratory that hydrolysates of protein, either from meat or commercial casein, contain a large amount of plain-muscle-stimulating factors, most of which cannot be accounted for as histamine (Bose, *Proc. Nat. Inst. Sci.*, 1955). Further work showed that Protein hydrolysate unlike histamine exerts a powerful antidiuretic action in hydrated rats, which is comparatively greater than that exerted by equivalent amount of 5-hydroxy tryptamine or serotonin.

In continuation of these findings, clinical studies were carried on patients of malnutrition and anaemia, to study the effect of protein hydrolysate transfusion on diuresis. It was observed that in hydrated individuals and in cases, associated with oedema, there was considerable anti-diuretic action, after transfusion.

41. Effect of tannin substances on growth and metabolism of nitrogen, phosphorus and calcium in rats.

L. V. L. SASTRY, H. S. R. DESIKACHAR & M. SRINIVASAN, Mysore.

Tannins are important constituents of foods especially of fruits and of certain edible materials like arecanut. Yet the role of tannins in metabolism has not been very clearly understood apart from the reports that administration of tannic acid has an adverse effect on calcium and phosphorus utilisation and leads to incidence of liver necrosis. The present work relates to the effect of feeding certain tannin-bearing foodstuffs on rat growth and nitrogen, calcium and phosphorus balance in rats. *Amla* (Indian gooseberry, *Phyllanthus emblica*), processed arecanut (*Areca catechu*) and myrobalan (*Terminalia chebula*) have been chosen as sources of tannin in this study.

Preliminary studies on adult rats indicated that the inclusion of 5% amla powder in the diet caused a greater excretion of both nitrogen and calcium in the feces. Further experiments on young weanling rats fed for 8 weeks on an adequate diet supplemented with amla (at 5 and 10 per cent levels in the diet) arecanut (1%), myrobalan (1%) and tannic acid (1%) showed retardation in growth as compared with the control diet with no added tannin. Also, an increase in the bulk of feces voided was observed in the tannin supplemented groups. A larger excretion of nitrogen was also noted in the feces. The data on calcium showed a similar trend, suggesting an inhibitory effect of tannin with respect to calcium absorption. The significance of these results will be discussed.

42. Effect of heated fat on the phosphatase activity of intestine and liver.

D. SINHA, & P. B. SEN, Calcutta.

Fats heated over 300°C for about 3 hours in presence of air was found to develop properties which is harmful from the nutritional point of view. The effect of ingestion of such fat for a long time was found to affect the concentration of the intestinal alkaline phosphatase enzymes adversely, whereas the liver phosphatase was slightly but significantly increased. This has been established by histochemical and biochemical methods. Acid and alkaline phosphatases of intestine and liver were also found to be inhibited by heated oil in vitro experiments.

43. The relative value of the proteins of Indian multipurpose food, bengalgram (Cicer arietinum) and skimmed Milk powder in meeting the protein requirements of protein depleted animals.

KANTHA JOSEPH, M. NARAYANA RAO, A. N. SANKARAN, M. SWAMINATHAN & V. SUBRAHMANYAN, Mysore.

Three groups of protein depleted rats were fed on diets containing Multipurpose food, Bengal gram and skimmed milk powder for a period of 21 days. The diets contained 14% of protein. The average food and protein intake of the different groups of animals were nearly equal. The animals fed on skimmed milk powder retained greater amounts of nitrogen than those fed on Multipurpose food and Bengal gram respectively. The body water content of rats fed on the Bengal gram diet was slightly higher than that of rats fed on diets containing skim milk powder or Indian Multipurpose food. The increase in cell solids of the rats fed on diets based on skimmed milk powder or Multipurpose food was slightly greater than that observed in rats fed on Bengal gram diet. The ability of the different protein foods to meet the protein requirements of the protein depleted rats ranted in the following descending order: Skimmed milk powder, Multipurpose food and Bengal gram.

44. Studies on the Composition, Storage and Nutritive Value of Palm Oil.

K. KRISHNAMURTY, M. NARAYANA RAO, M. SWAMINATHAN, D. S. BHATIA and V. SUBRAHMANYAN, Mysore.

The paper deals with studies on the relative stability and nutritive value of refined and deodourised palm oil, palm oil blend as compared to hydrogenated groundnut oil. The physical and chemical composition and carotene content of the different samples were determined. The keeping quality of the palm oil and the blend was nearly the same as that of hydrogenated groundnut oil. Addition of B. H. A. and propyl gallate along with citric acid enhanced the keeping quality of the different fats. No significant difference was observed in the growth promoting value, digestibility and in the amount of calcium and phosphorus retained by different groups of rats fed diets containing palm oil, palm oil blend and hydrogenated groundnut oil.

45. Studies on the Preparation of Infant Food from Buffalo Milk—I. Effect of Heat Processing and addition of Citrate and Phosphates on the Curd Tension of Buffalo Milk.

M. R. CHANDRASEKHARA, M. SWAMINATHAN, D. S. BHATIA and V. SUBRAHMANYAN, Mysore.

A simple curd tension meter for determining the curd tension of milk has been described. The effect of heat processing and addition of phosphates and citrate on the curd tension of buffalo milk has been studied. It has been found that the curd tension of buffalo milk is reduced to a very low figure as a result of heat processing and addition of phosphates and citrates.

46. Studies on the Preparation of Infant Food from Buffalo Milk—II. Standardisation of conditions for the Preparation.

M. R. CHANDRASEKHAR, V. SREENIVASAMURTHY, M. SWAMINATHAN, D. S. BHATIA and V. SUBRAHAMANYAN, Mysore.

Infant food having a low curd tension, good solubility and palatability and low bacterial count has been prepared from buffalo milk collected in a dairy in Mysore. An infant food having a low bacterial count (35600/per g. of powder) could be prepared from liquid milk having high bacterial count (3-4 millions). When milk is collected in sterilised vessels and transported in a chilled condition, the bacterial count of the raw milk as well as that of condensed milk and infant food has been found to be very low. Collection and storage of milk for 1 and 3 hours in brass vessels has been found to increase the copper content of the infant food to 8·3 p.p.m. and 14·1 p.p.m. respectively while infant food prepared from milk collected and stored in aluminium vessels had a law copper content (4·4 p.p.m.).

47. Studies on the Preparation of Infant Food from Buffalo Milk—III—The Shelf-Life of the Product.

M. R. CHANDRASEKHARA, M. SWAMINATHAN, D. S. BHATIA and V. SUBRAHMANYAN, Mysore.

The keeping quality of infant food prepared from buftalo milk using Niro spray drier and packed in air and in nitrogen has been studied. The food prepared from milk, collected in aluminium vessels under average prevailing conditions in dairy, and packed in 8 oz. cans under nitrogen (7·5% O_2 in headspace gas) had a shelf-life of 8 months at 37°C and about 16 months at 27°C. An infant food having a low bacterial count (4 thousand) and satisfactory shelf-life could be prepared from dairy milk having a high bacterial count (4-5 millions). Contamination of fluid milk with copper caused by keeping the milk in brass vessels, affects adversely the shelf-life of the infant food. Fair agreement was observed between the development of off-flavour assessed organoleptically and the peroxide value of the fat in the powder.

48. Studies on the Comparative Utilization of Glucose, Fructose and Galactose in Alloxan Diabetes.

SACHCHIDANANDA BANERJEE and ESWARAMANGALATH RAMANKUTTY DIVAKARAN, Calcutta.

The comparative utilization of three monosaccharides viz., glucose, fructose and galactose, administered intravenously was studied in normal and alloxan-diabetic rabbits.

Blood samples obtained before and at intervals after administration of these sugars were analysed for the total sugar, inorganic phosphate and fructose or galactose. True blood glucose values were calculated by subtracting the glucose equivalent of fructose or galactose from the total sugar. Samples of 24-hour urine collected after the administration of different sugars were analysed for individual sugars in the case of normal habbits and for total sugar as well in the case of diabetic animals. The 24-hour urinary output of glucose as well as fructose or galactose was also estimated after administration of the different sugars in non-fasted diabetic rabbits. The effect of dihydroergotamine on blood glucose was also studied by injecting 0·4 mg. of the substance into normal and diabetic rabbits prior to administration of fructose.

Diabetic animals remove fructose and galactose from the blood as readily as normal animals. The amounts of these sugars eliminated in the urine are not significantly different in the two groups. Obviously the initial stages of the metabolism of these sugars proceed normally in diabetes and that insulin does not mediate the actions of fructokinase and galactokinase.

However, administration of fructose and galactose is accompanied by elevations of blood glucose, which are of considerable magnitude in diabetic animals. Commensurate with this inceease in blood glucose and the severity of diabetes, there is enhanced glucosuria. Injection of dihydroergotamine partly suppresses the elevation in blood glucose after fructose in normal rabbits, but not in diabetic ones. The rise in blood glucose occurring after administration of fructose and galactose might be due to conversion of these sugars into glucose prabobly by the liver. The abnormal increase seen in diabetic animals might be either due to their inability to utilize the glucose so formed or due to enhanced rate of conversion.

When the over-all utilization of fructose and galactose by diabetic animals is assessed, they appear to be assimilated only slightly better than glucose. Hence, the superiority of these sugars over glucose as metabolic fuels in diabetes does not seem to be much.

49. The Digestibility and Nutritive Value of Hay Mixture.

N. D. KEHAR, P. N. JOHRI and B. S. GUPTA, Izatnagar.

A hay mixture composed of Ermopogon fabeolatus 29·4 percent, Andropogon pumilatus (Gerua) 25·3 per cent, Aristida species 21·2 per cent, Alpudia mutica (Bhanjura) 17·8 per cent and Misc. [Heteropogon contortus and Bothriochloea pertusa] 6·2 per cent, was chemically analysed and was found to contain crude protein 6·95 per cent, ether extract 0·98 per cent crude fibre 48·87 per cent, nitrogen free extract 32·7 per cent, total ash 10·5 per cent calcium 0·48 per cent and phosphorus 0·17 per cent.

A metabolic trial was conducted on four adult hill bullocks of an average body weight of 387·5 lb. During the feeding regime of about a month the animals recorded an average gain of 5 lb. per head and maintained a general healthy appearance. The hay mixture was consumed at the rate of 1·77 lb. per 100 lb. body weight, showing that it was palatable.

The digestible coefficients of hay mixture for the crude protein, ether extract, crude fibre and nitrogen free extract were 34, 40, 41 and 59 respectively.

The digestible crude protein, total digestible nutrients and starch equivalent values, in lb., per 100 lb. of hay mixture, were 2·36, 45·66 and 17·04 respectively.

The experimental animals were in positive balances for nitrogen, calcium and phosphorus.

50. Digestibility and Nutritive Value of Hay Mixture.

N. D. KEHAR, P. N. JOHRI and B. S. GUPTA, Izatnagar.

A hay mixture of Dicanthium annulatum (bara jerga) 33·3% Heteropogon contortus (Sarwala) 22·2%, Alpudia mulica (Bhanjura) 21·0%, Ischelium laxum (musel) 14·8% Bothriochoea pertusa (choti jergi) 6·8% and misc. Andropogon Sp. 1·9 per cent was chemically analysed and was found to contain :—crude protein 6·95 per cent, ether extract 1·09 per cent crude fibre 43·20%, nitrogen free extract 39·36 per cent and phosphorus 0·175 per cent.

Digestibility and nutritive value of hay mixture was determined by using adult Kumauni bullocks of an average body weight of 403·7 lb. During the feeding period of about a month the animals recorded on an average gain of 6 lb. per head and maintained a general healthy condition. The hay mixture was consumed at the rate of 775·5 gm. per 100 lb. live weight showing that it was fairly palatable.

The digestibility coefficients of the hay mixture for the crude protein, ether extract, crude fibre, and nitrogen free extract were 39%, 44%, 44% and 54 per cent respectively.

The digestible crude protein, total digestible nutrients and starch equivalent values, in lb. per 100 lb. of hav mixture, were 2·43 lb., 43·96 lb. and 18·59 lb. respectively.

The experimental animals recorded positive calcium phosphorus and nitrogen balances.

51. Utilization of urea as a protein substitute in the ration of growing calves.

N. D. KHER, P. C. SAWHNEY and P. N. JOHRI, Izatnagar.

In view of the acute shortage of protein rich concentrates and encouraging results obtained in Western countries on the use of urea as a protein supplement for ruminants, it was considered advisable to study the effect of utilizing urea as a protein substitute in the ration of growing calves.

Twenty four calves were selected and divided into four groups of six each. The four groups represented one of control and the three experimental receiving urea supplement at rate of 10%, 20% and 30% of the protein requirement respectively. The rations of the animals of the four groups were made isocalaric by adding starch to the ration of the experimental groups.

During the feeding regime, which lasted for a year, the animals were weighed weekly. The average gain in live-weight per week were 5·89 lb., 5·28 lb., 4·83 lb.

and 4·36 lb. at the end of 30 weeks and the average grain in weight per week between 31st and 52nd weeks were 6·2 lb., 5·5 lb., and 5·9 lb. for the control and experimental groups I, II and III respectively.

A metabolic trial was conducted after a period of nine months. There was practically no difference in the digestiblity coefficients of crude protein and ether extract in the four groups. However, there appeared a tendency of decrease in the digestibility coefficient of crude fibre with the increase in the amount of urea in the ration.

The total digestible nutrients of rations, per 100 lb. dry matter, were 67·70 lb., 66·30 lb., 69·13 lb. and 73·09 lb. for the control group and experimental groups, I, II and III, respectively.

The animals of the four groups were in positive balance for nitrogen, calcium and phosphorus. The percentage retention of nitrogen was more in the control group animals than in the experimental groups I, II and III, respectively.

52. Physiological behaviour of growing calves on rations supplemented with urea.

N. D. KEHAR, P. C. SAWHNEY and P. N. JOHRI, Izatnagar.

In view of the favourable results obtained in Western countries on the use of urea for ruminants, it was considered desirable to study the effect of incorporating urea in the ration on the physiological behaviour of growing calves.

Twenty four hariana calves were divided into four groups of six each. The four groups represented one of control and the three of the experimental, receiving urea supplement at the rate of 10%, 20% and 30% of the digestible protein requirement in rations of three groups. The rations of the animals were made isocaloric by adding starch to the ration of the experimental groups.

During the feeding regime physiological studies on pulse rate per minute, respiration rate per minute and temperataure were made at fortnightly intervals. The average pulse rate of the animals was 55, 58, 59 and 54 per minute, in the beginning of the experiment and was 50, 52, 53, and 50 per minute at the end of the experiment in the control and experimental groups I, II and III respectively. The respiration rate of the animals was 25, 23, 26 and 22 per minute in the beginning of the experiment and was 27, 28, 28 and 25 per minute at the end of the experiment in the control and experimental groups, I, II and III respectively. The temperature of the animals was 101·9°F, 101·8°F, 101·7°F and 101·6°F at the start of the experiment and was 101·2°F, 101·3°F, 101·3°F and 101·1°F at the end of the experiment in control and experimental I, II and III groups respectivly. Therefore, it is apparent that inclusion of urea, in the amounts given above, in the ration of dairy calves, had no effect on pulse rate per minute, respiration rate per minute and temperature of animals.

53. Studies on the nutritive value of oil cakes:—Part I. Nutritive value of ground nut (Arachis hypopaea) cakes prepared by ghani, expeller and solvent extraction processes.

N. D. KEHAR, K. SAHAI, M. L. MATHUR and P. N. JOHRI, Izatnagar.

Since considerable controversy exists as to the possible effect of feeding cake produced by solvent extraction process as compared to cakes produced by ghani and expeller processes, experiments were, therefore, planned to study the comparative nutritive value of the ghani, expeller and solvent extracted ground nut cakes. The cakes were fed to 3 comparable groups of adult Kumauni bullocks to meet their digestible protein requirement and wheat bhoosa was fed as the sole roughage to all the animals. The rations were fed for one month and a metabolism trial was conducted during the last ten days.

The percent level of ether extract in total ration was 4·78, 1·68 and 2·11 for the solvent extracted, expeller pressed and ghani pressed ground nut cake groups respectively.

The T. D. N. of rations, per 100 lb. dry matter were 52·25 lb., 54·09 lb. and 54·22 lb. for the solvent extracted, expeller pressed and ghani pressed cake groups respectively.

The digestible crude protein, per 100 lb. of dry matter, for ghani pressed, expeller pressed and solvent extracted ground nut cakes were found to be 47·02 lb., 45·47 lb. and 46·95 lb. respectively.

The balance for nitrogen were positive in all the three groups while those for calcium and phosphorus were slightly negative.

54. Studies on the Nutritive Value of oil cakes.—II. Nutritive Value of Sarson (Brassica compestries) cake prepared by ghani, expeller and solvent extraction processes.

N. D. KEHAR, M L. MATHUR, P. N. JOHRI and P. T. VARANDHANI,
Izatnagar.

In view of the acute shortage of fat for human consumption and paucity of information regarding the desirability of feeding solvent extracted cake to cattle it was considered desirable to undertake a feeding experiment and to determine the nutritive value of *sarson* cake prepared by solvent extraction process and to compare it with cakes produced by ghani and expeller pressed processes.

A metabolic trial was conducted on three comparable groups of kumauni (adult) bullocks of four each. Cakes, prepared by three different groups to meet their digestible crude protein requirement and wheat bhoosa was fed as the sole roughage to all the animals. The above dietetic regime was extended over a period of one month .

The digestible crude protein in lb. per 100 lb. of dry matter, was found to be 21·27 lb., 30·39 lb. and 30·98 lb. for solvent extracted, expeller pressed and ghani pressed sarson cakes respectively. The average total digestible nutrients of the rations in lb. per 100 lb. dry matter were found to be 48·55, 48·95 and 50·85 lb. for the solvent extracted, expeller and ghani pressed cake groups respectively.

During the above feeding regime the animals of the three groups were in positive balance for nitrogen, calcium and phosphorus.

55. Clinical Syndromes and Histopathological changes in experimental Vitamin A Deficient Goats.

BRAHM DUTT and N. D. KEHAR, Izatnagar.

Adult male goats of 2-3 years of age were kept on almost carotene free diet for about one year and eight months. Corneal ulceration and opacity, unthrifty condition, night blindness, elongated brittle hooves and falling of hairs in patches were the characteristic clinical symptoms. Most of the vitamin A deficient goats suffered from diarrhoea and pneumonia. Specific histopathological changes of metaplasia and keratinisation were observed in the cornea and trachea of the vitamin A deficient goats. Areas of calcification were observed in the renal pelvis.

56. Effect of Hyperthermia on Avian Blood Sugar.

BATUKESWAR RAY and D. P. SADHU, Calcutta.

When the pigeons are exposed to a higher temperature, their blood sugar becomes higher than the normal value after two hours of exposure. It was thought desirable to study the time course of this thermoglycemic response. Blood sugar was estimated at half-hourly intervals upto 2 hours of exposure at 45°C ambient temperature. Result showed that there was a rise of blood sugar which was more marked in the beginning and this was followed by a less marked rise at 2 hours.

57. Effect of milling on the Nutritive Value of Jowar (Sorghum vulgare).

M. NARAYANA RAO, GOWRI SUR, M. SWAMINATHAN and
V. SUBRAHMANYAN, Mysore.

The effect of polishing on the chemical composition and nutritive value of jowar has been studied. Polished jowar was found to contain lesser amounts of fibre, calcium, phosphorus, iron and thiamine than unpolished jowar. Both *ad lib* feeding and paired feeding experiments showed that a poor vegetarian diet based on unpolished jowar promoted significantly higher growth in rats than a similar diet based on polished jowar. Rats fed on unpolished jowar diet retained significantly larger amounts of nitrogen and phosphorus than those fed on polished jowar diet.

58. Chemical Composition and Nutritive Value of Sain (Sehima Nervosum) Grass Hay.

N. D. KEHAR, K. SAHAI and V. P. SHUKLA, Izatnagar.

Sain (other local names naunat, sheda, suckal etc.) is a perennial grass growing in compact tufts with leafy and bushy growth. The species is widely distributed throughout India and also other countries like Australia, Sernaliland, Abyssinia, Eritrea, Socotra and Cape Verde Islands. It is reputed to be the mainstay of the Amritmahal breed of cattle of Mysore in India. It is very common in the Carnatik region and the black soil area in the Madhya Pradesh.

The percentage chemical composition of the grass hay (flowering stage) on dry basis was found to be: crude protein, 2·80; ether extract, 0·77; crude fibre, 41·18; nitrogen free extract, 44·5; total carbohydrates, 85·68; calcium (Ca), 0·50 and Phosphorus, (P), 0·15.

The nutritive value of the grass hay was determined by conducting a metabolism trial on six kumaoni bullocks. The ration consisted of the hay being fed *ad lib.* together with the requisite quantity of linseed cake so as to meet their maintenance requirement of digestible crude protein and 1 oz. of commonsalt per animal per day. The average percentage digestibilities of crude protein, ether extract, crude fibre, nitrogen free extract, and total carbohydrates, were found to be 11·6, 9·8, 59·2, 50·6 and 54·7 respectively.

The digestible crude protein, total digestible nutrients and starch equivalent values in lb. per 100 lb. of the dry hay were found to be 0·325, 47·36 and 23·88 respectively. The average daily balances for nitrogen, calcium and phosphorus were found to be positive. The animals maintained their body weight during the experimental feeding period which extended over 34 days.

The grass hay at the flowering stage of growth was quite palatable and the average daily consumption was found to be 2·17 lb. per 100 lb. body weight.

The above observations indicate that the sain grass hay in the flowering stage, can form a maintenance ration when supplemented with a little oil cake.

59. Unit of Venom Haemolysin.

A. C. ROY, Howrah.

Slotta et al (Memorias do Instituto Butantan, p. 133, 1937, quoted by De, Ind. J. Med. Res. 27, 531, 1939) measured the haemolytic activity of venoms by adding the solution of the venom to a mixture containing a buffer, lecithin and horse r.b.c. The maximum amount in gamma which haemolysed the mixture in two hours was taken as the 'lecithinase unit'. De (loc. cit.) adopted a similar procedure in determining the haemolytic power of a venom. Apparently these workers consider the haemolysin and the lecithinase of the venom to be identical.

Roy (Nature, June 9, 1945) found that haemolysis effected by a venom alone and that effected in the presence of lecithin are two distinct processes and that lecithinase is not identical with the haemolysin of the venom. For instance, cobra venom alone is haemolytic towards the susceptible species of r.b.c. but Russell's viper venom is not. But with a trace of lecithin both these become strongly haemolytic even towards the most resistant species of r.b.c. which are not lysed by any of the known venoms alone. Such a system, therefore, which contains lecithin as one of its constituents, does not give a correct idea of the haemolytic power of the venom in its native state. It does not even afford a measure of its lecithinase activity, as it has been repeatedly found (Roy, unpublished; Kyes, J. Inf. Dis. 7, 181, 1910), that with a given proportion of r.b.c. and lecithin, an increase in the concentration of a venom beyond a certain point results in progressive diminution of its haemolytic activity.

60. Biological degradation of Folic Acid and derivatives by rat liver.

BEATRIZ M BRAGANCA and U. W. KENKARE, Bombay.

In continuation of studies on folic acid degrading enzymes in blood reported at a symposium last year, (Ind. Sc. Cong. 1957) investigations have been carried out on the occurrence of similar enzyme systems in rat liver.

It has been possible by fractionation with Ammonium Sulphate to separate the system cleaving folic acid from the one responsible for the inactivation of folinic acid (CF) in the liver. Furthermore A-meth-pterin has been found to selectively inhibit the folic acid degradation without affecting the cleavage of CF. Both the enzyme systems require ATP, Mn++, DPN and citrate for activity. Omission of any one of the co-factors considerably reduced the activity towards either substrate. The properties described will also show that enzymes catalysing the cleavage of CF in rat liver is presumably not identical with a similar enzyme system reported earlier in horse liver. In extension of these studies, the relation of folic acid regradation to cellular growth will also be discussed.

61. Assay of Cortisone and Hydrocortisone based on Eosinopoenia in adrenalectomised rats using a special procedure of calculation.

B. N. CHOWDHURI, Calcutta.

Adrenal steroids, hydrocortisone and cortisone produce eosinopoenia as well as leucocytosis. This eosinopoenic response is not uniform and it is difficult to establish relationship with dosage of the hormone except by special statistical treatment of the data. Leucocytotic response, similarly, is not of uniform nature.

In the present paper, it has been shown that eosinopoenic response when expressed as percentage of the total leucocyte count, bears a definite relationship with the dosage of the hormone. In other words, both the eosinopoenic and the leucocytotic responses are taken into consideration in assaying the hormone. Using this special procedure of calculation, a method of assay of hydrocortisone and cortisone in adrenal-ectomised rats has been suggested. It has been shown that a straight line relationship exists between the log dose of the hormone and the eosinopoenic response expressed as percentage depletion is relation to total leucocyte count. The method appears to be simple and reasonably accurate.

62. Assay of corticotrophin in rats pretreated with Hydrocortisone or Morphine—preliminary observations.

B. N. CHOWDHURI and M. A. SAMPATH KUMARAN, Calcutta.

It has been shown that hydrocortisone or morphine injection in normal rats causes inhibition of secretion of corticotrophine after stressful stimuli. The possibility of using rats pre-injected with hydrocortisone or morphine instead of hypophysectomised rats for the assay of corticotrophin has been examined. A straight line relationship of the log dose response at certain range has been observed. Adrenal ascorbic acid depletion has been taken as the index of acivity of corticotrophin. Preliminary observations show the method to be reasonably accurate and satisfactory with some advantages over the official method.

63. The effect of Triiodothyronine on the genital organs of adult male rats.

AMIYA B. KAR, S. N. ROY and R. P. DAS, Lucknow.

Two doses of triiodothyronine (TIDT)—a *low* (3μg./rat/day) and a *high* (12μg./rat/day) were injected separately into two groups of adult male rats for 18 days by the intramuscular route. For the sake of comparison two other groups of male rats of the same age were injected with identical doses (3μg. and 12μg.) of thyroxine (T) in a similar manner and for the same period. All of the treated animals were sacrificed on the 19th day with appropriate controls. It was seen that both doses of TIDT caused a significant reduction in testicular weight and the extent of such reduction was proportional to the dosage. The low dose (3μg.) of T, on the other hand, did not evoke any significant change in testis weight but the high dose (12μg.) caused a significant loss in the weight of this organ. Comparative assessment revealed that the two doses of TIDT though caused somewhat greater reduction in testis weight than the corresponding identical doses of T, yet the differences were not statistically significant. Added to this, no histologic change could be discerned either in the spermatogenic or in the interstitial elements after administration of the two hormones in low and high doses. Nevertheless, dramatic changes were seen when the effect on the seminal vesciles (S.V.) was considered. It was noticed that the control value of S.V. weight (247 ± 19·7 mg.) was significantly reduced (to 163·2 ± 10·1 mg.) after administration of the low dose (3μg) of TIDT; with the high dose (12μg.) the S. V. weight dropped drastically to 47·7 ± 5·9 mg. It was therefore evident that the S.V. were reduced to less than 1/5th their normal weight after administration of 12μg. of TIDT and their histologic picture resembled that of the castrates. T also caused a reduction in S. V. weight. Thus against the control value of 247·1 ± 19·7 mg. the S. V. of animals injected with the 3μg. dose weighed 175·0 ± 6·11 mg. and those of the animals given 12μg. dose weighed 148·±7·29 mg., both the values were significantly lower than that of the controls. Like TIDT, the extent of reduction of S. V. weight caused by T was proportional to the dosage. From comparative standpoint, however, the reduction in S. V. weight caused by the 3μg. dose of TIDT was slightly more than that caused by the 3μg. dose of T though the difference was not statistically significant; but the 12μg. dose of TIDT caused more than 3 times reduction in S. V. weight as compared to 12μg. dose of T.

64. The effect of 19-Nortestosterone on mating and pregnancy in rats.

AMIYA, B. KAR, Lucknow.

19-Nortestosterone (19NT) injections to rats during the prepubertal period had no effect on the subsequent attainment of sexual maturity, mating and conception. In mature female rats the injection of this compound invariably produced a characteristic irregularity of the estrus cycle without, however, disturbing the cyclicity of the phenomenon. This irregularity consisted of the presence of mixed type of cells in the vaginal smears during full estrus instead of 100% cornified cells typical of this stage of the cycle. Injection of 19 NT (for 24 days) before mating had no effects on mating and conception. Similar treatments (for 24 days) either *before and during mating* or only *during mating* invariably caused a significant delay in mating but did not interfere with conception. Prolonged injections (for 60 days) resulted in delayed as well as sterile matings and completely stopped pregnancy throughout the period of treatment. The animals remained in a pseudopregnant condition during this period. The pseudopregnant condition persisted even during the post-treatment period for an average of 42·2 days after which the cyclicity of the estrus phenomenon resumed in normal manner. Majority of these animals mated and conceived indicating that the effect of 19NT on pregnancy was only a temporary one. *Oral administration* of this compound either once or twice a month had no effects on estrus, mating and conception in rats.

65. Effect of Ovariectomy (Bilateral) on body growth and thymus in young female rats.

T. JANARDANA SARMA & M. SIRSI, Bangalore.

Ovariectomy in young female rats (40 days age) causes accelerated body growth (30% gain in weight, 5 weeks after ovariectomy) and hypertrophy of thymus (60% over normal weight).

There is a significant rise in the level of serum inorganic phosphorous (10·7 mg/100 ml) in the overiectomized rats, compared to normal rats (9·2 mg/100 ml).

The hypertrophy of thymus, as a result of ovariectomy is shown to be true tissue growth, as it contains, the same percentage of water (78%) Desoxy-ribose-nucleic acid (2·7γ/mg fresh tissue), and protein (78% on dry weight) as the normal thymus.

The level of total Ascrobic acid in the hypertrophied thymus (59·0γ/100 mg. fresh tissue) is also maintained at the same level as in normal thymus (59·3γ/100 mg. fresh tissue).

Thymectomy of previously ovariectomized animals, would be useful in establishing whether or not the thymus is implicated in the accelerated body growth, resulting from ovariectomy.

66. Comparative study on the actions of penicillin and thiourea on the metamorphosis of tadpoles.

A. K. MEDDA & G. C. BHATTACHARYA, Calcutta.

It has been reported that penicillin delays the metamorphosis of tadpoles (Rana tigrina) upto a maximum period of 15 months by its bacteriostatic and bactericidal actions on the vitamin B_{12}-producing bacteria in the intestine, whereas vitamin B_{12} can initiate the metamorphosis of the retarded tadpoles within about 10-15 days. Thiourea, an anti-thyroid drug, is responsible for the inhibition of biosynthesis of thyroxine by inhibiting the activity of peroxidase enzyme system. Naturally, if the formation of thyroid hormone is blocked by thiourea in tadpoles, their metamorphosis would be retarded. A comparative study on the actions of thiourea and penicillin on the metamorphosis tadpoles (Rana tigrina) was made. Out of 100 tadpoles taken in penicillin treated groups (conc. of penicillin = 80 units per c.c.), 70 tadpoles metamorphosed at the end of eight months, 20 died within four months and the remaining 10 died at the end of ten months. In thiourea treated groups (100 tadpoles; conc. of thiourea = 0·05 per cent) not a single tadpole metamorphosed up to ten months and 25 died within five months. The surviving larvae (75) died in the early period of eleventh month, possibly due to low temperature in winter season. The control tadpoles developed into froglets within the usual time. The other peculiarity is that the tadpoles in penicillin treated groups grew in size to some extent, whereas the growth of the thiourea treated larvae was completely checked. It seems, therefor, that thiourea has a greater metamorphosis-retarding action than penicillin. Penicillin can delay the metamorphosis and thiourea can check both growth and differentiation in tadpoles.

67. Studies on the progressive changes in pancreatic activity of guineapigs subjected to daily injections of some diabetogenic agents.

H. D. BRAHMACHARI & MAHENDRA KUMAR, Pilani.

A large number of pure chemical compounds have been reported in the past few years to be capable of producing clinical symptoms simulating Diabetes Mellitus in laboratory animals. The diabetogenic effect of each compound seems to differ from that of the others and a detailed investigation on the mode of action of each of such agents has therefore been undertaken.

Preliminary observations on the diabetogenic effect of Alloxan and B. hydroxy-butyric acid (sodium salt) in guinea pigs, have been carried out and it appears that these substances when injected in gradually increasing daily doses, tend to produce a hypertrophy in both the acinar and insular cells. This results in an initial stage of increased production of both the pancreatic hormones and enzymes, which is evidently followed in the last stages by an over-work atrophy of the secreting cells resulting in a decreased production of the hormones and possibly also of the enzymes. The results of histochemical and histopathological studies as also of enzyme and hormone assay of pancreases from experimental animals at different stages of injections, go to support the above hypothesis.

Further work is in progress.

68. Studies on Thiazole derivatives—A new series of antihistamining compounds.

J. K. MOHANTY & P. TRIPATHY, Cuttack, Orissa.

Examination of chemical configuration of a number of compounds, which were synthesized from 4-aryl-2-aminothiazole revealed that some of them possess the basic grouping, either as a straight chain or as a part of a ring structure, believed to be necessary for anti-histaminic action. In view of this, 32 compounds of this series were screened for possible antihistaminic activity. Blockade of action of histamine on guinea pig's intestinal strips in isolated organ bath and prevention of the blood pressure lowering effect of histamine on anaesthetised dogs were used as the test methods. Compounds exhibiting fairly good antihistaminic action were picked up for further study. Dose-response relationship and antihistaminic potency were worked out. Relative antihistaminic potency was studied by using Antazoline hydrochloride (Antistin) as the reference standard drug. Calculations were made by probit analysis on the basis that the intestine could be considered to be composed of a population of muscle fibres, the response of which would vary according to frequency distribution of any other biological variate.

Five compounds of this series exhibited fairly good antihistaminic activity. Of these the most active compound is a derivative of pyrazolinyl-tetra-hydrobenzothiazole group. As an antihistaminic it is one third as potent as Antazoline hydrochloride, which is a clinically well established and commonly used drug. Further work is in progress.

69. The distribution of hexamethonium in various body tissues in normal, Nephrectomised and eviscerated cats.

J. K. MOHANTY, Cuttack, Orissa.

Samples of blood were collected from anaesthetised normal cats at varying time intervals after an intravenous dose of hexamethonium bromide (HMB) and finally the animals were sacrificed and samples of liver, kidney, spleen, heart, lung, muscle, brain and C.S.F. were collected. The blood was heparinised and the separated plasma was kept for testing. The various tissues were chilled and extracted as reported by the author previously. These extracts of various tissues and the plasma were tested biologically for the estimation of HMB content on vascularly isolated superior cervical ganglion—nictitating membrane preparation perfused with a blood substitute, a preparation which was worked out by the author and published elsewhere. These experiments were repeated on bi-laterally nephrectomised cats and on eviscerated cats which had also had bilateral nephrectomy. The experiments were otherwise as before.

This study revealed that there was no lowering of HMB concentration in body fluids and tissues in eviscerated cats which had had bilateral nephrectomy as well. In bilaterally nephrectomised cats without evisceration the progressive lowering of HMB concentration in body fluids and tissues were somewhat slower compared to that in normal cats, but the drug did disappear ultimately.

There seems to be unequal distribution of HMB in body fluids and tissues. The blood contains most HMB, followed by the kidney, muscle, spleen, heart, lung, brain and C.S.F. in order of decreasing concentration. No HMB was ever detected in the liver—a result which lends further support to the reported finding of the author that the liver contains a principle which inactivates or degrades HMB.

70. "The influence of some Autonomic Drugs on the activity of the spontaneously beating Isolated Frog's Heart and its sinoauricular chamber."

C. L. PATHAK, M.D., Jaipur.

The actions of various concentrations of four autonomic drugs including adrenaline, nicotine, escrine and atropine have been studied on spontaneously beating isolated frog hearts. It has been found that all the four drugs give both excitatory and inhibitory effects. A pure excitatory effect leading to simulaneous acceleration and augmentation of the heart beat was only common with adrenaline. The excitatory effect of atropine, nicotine or eserine was only occasional and was more marked on the inotropic response. The inhibitory effect of all the drugs can be easily obtained specially at higher concentrations. Both the inotropic and chronotropic responses were inhibited and the heart beat could be completely arrested. Neither the excitatory nor the inhibitory effect was universal. Some hearts were either unresponsive from the beginning or became unresponsive in some trial or the other to the action of eserine, atropine and adrenaline. The possible mechanism of action of these drugs have been discussed in the light of the proposed hypothesis of operation of acetylcholine synthesis destruction cycle for the initiation and maintenance of heart beat. These observations lend further support to such a view for otherwise the results are difficult to explain. It has been suggested that the site of action of these drugs may be the acetylcholine synthesising tissue or the acetylcholine reactive surfaces.

71. "The antiarrhythmic and antiveratrinic action of certain antihistaminic drugs."

R. B. ARORA & P. L. SHARMA, New Delhi.

The antiarrhythmic properties of N-Dimethyl aminoethyl-N-p-chlorobenzyl-a-aminopyridine hydrochloride (Synopen), mepyramine maleate and promethazine hydrochloride were investigated and compared with quinidine ;

(1) In acetylcholine-induced auricular fibrillation, 2·5 mg/Kgm. of Synopen brought about a greater reduction in the duration of fibrillation than quinidine, mepyramine maleate and promethazine hydrochloride were weaker than quinidine in this respect.

(2) In aconitine-induced auricular fibrillation, the end point was reached with 2mg/Kgm. of Synopen ; 22 mg/Kgm of mepyramine maleate, 14 mg/Kgm. of promethazine hydrochloride and 16 mg/Kgm of quinidine.

(3) In auricular flutter produced by injury stimulation method, 1mg/Kgm. of Synopen, 20 mg/Kgm. of mepyramine maleate, 18 mg/Kgm. of promethazine hydrochloride and 21 mg/Kgm. of quinidine produced reversion to normal sinus rhythm.

(4) In their ability to avert hydrocarbon epinephrine induced ventricular arrhythmias, only Synopen was found to be more potent than quinidine.

These compounds were investigated further for the antiveratrinic activity and the results have confirmed our earlier assumption of the possibility of unusual parallelism between antiveratrinic and antiarrhythmic properties of compounds of diverse structure. Keeping the antiarrhythmic activity in view Synopen seems promising and deserves clinical trial.

72. Comparative study of the actions of reserpine and phenobarbitone on the Metrazol-induced seizure activity in rabbits, with the help of electroencephalograph.

N. N. DAS, CHANDIDAS DEY & K. C. DAS, Calcutta.

Rauwolfia serpentina is a reputed drug in the indigenous system of medicine for a long time. Reserpine, one of its alkaloids, extracted from the root of R. serpentina, has been known to possess sedative and tranquillising effects on man and animal.

In the work undertaken by us, we have studied the comparative action of reserpine and phenobarbitone regarding the electrical activity of brain and behavioural changes in rabbits. We have also tried to show the efficiency of reserpine to modify metrazol-induced seizure activity in comparison to phenobarbitone. Along with above-mentioned properties, reserpine has been found to exert a slowing effect on the brain wave pattern and diminished alertness in the animals.

73. Electroencephalographic study of the actions of Rauwolfinine on rabbit brain.

CHANDIDAS DEY & N. N. DAS, Calcutta.

Rauwolfinine, a new alkaloid, recently isolated from the root of Rauwolfia serpentina by Chatterjee et al and Bose, was first investigated by Dasgupta et al for its pharmacological properties. But the central effect of the alkaloid with exact changes in the brain activity has not been investigated so far. This aroused our interest to study the action of rauwolfinine on rabbit brain with the help of electroencephalograph. It was found that the fundamental action of rauwolfinine is to depress the electrical activity of the brain with considerable slowing in the amplitude and frequency of the brain wave pattern. There is a definite relation between the extent of depression and the amount of the alkaloid administered. Moreover, previous administration of a large dose of rauwolfinine in the animal partially modifies the convulsion inducing properties of metrazol.

74. Relative susceptibilities of intestinal organism to Garlic.

V. SUBRAHMANYAN, K. KRISHNAMURTHY, V. SREENIVASAMURTHY
& M. SWAMINATHAN, Mysore.

In view of the wide spread use of garlic, in the indigenous system of medicine, to cure a variety of intestinal disorders, it was desirable to find out the relative susceptiblities of intestinal organisms to garlic. The aqueous extract of mashed garlic was tested for its antibacterial activity on *E. coli, S. sonnei, M. aureus, S. faecalis* and *L. casei* by exposing the different organisms to various concentrations of garlic for different periods and counting the number of organisms by direct microscopic count method. The minimum concentrations of garlic required to inhibit the growth of lactic acid organisms like *L. casei* and *S. faecalis* were found to be more than that required for the inhibition of *E. coli, S. sonnei* and *M. aureus.*

75. Surface area measurements on buffaloes by surface integrator.

M. V. N. RAO & D. N. MULLICK, Izatnagar.

120 buffaloes (calves, and adult females and males) were used to measure the surface area with the instrument known as surface integrator. The description of the instrument and the detailed method have been described in the text.

The relation between the recorded surface area and the body weight is highly significant and it can be fitted in a straight line.

The regression equations of young and adult animals showed some variations but their differences are not significant. The formula can be suitably utilised for estimating surface area when the body weight of the experimental animal is over 250 kg. The observed figures showed that a separate formula for surface area for buffaloes should be established.

76. Studies on the draught capacity of Hariana bullocks.

D. P. MUKHERJEE, S. DUTT & P. BHATTACHARYA, Izatnagar.

Twentyfour Hariana bullocks were tested for the maximal loads that they were capable of drawing in carts for six hours in different seasons of the year, the loads being expressed in terms of percent body weights of the bullocks. It has been found that the maximal loads drawn by the bullocks varied from 310 to 514% of their body weights and the loads drawn in the rainy season were less than those drawn in winter. A significant seasonal variation in the respiration rate and body temperature was observed in the bullocks while drawing the maximal loads but no such variation was noticed in the pulse rate. The percentage of haemoglobin in the blood estimated immediately after work showed an increase in the majority of the bullocks in the rainy season and a decrease during winter.

Significant negative correlation was found between the resting pulse rate of the bullocks and the maximal loads drawn by them. No such correlation was observed with the respiration rate, body temperature, body weights and the maximal loads drawn by the bullocks.

SECTION OF PSYCHOLOGY AND EDUCATIONAL SCIENCES

President:—DR. A. K. P. SINHA, M.A. (Pat.), M.Sc., Ph.D. (Mich.)

Abstracts

1. Sensory dominance in visual perception.

NIROD MUKERJI, Gauhati.

This investigation deals with the issue of relative dominance in a visual stimulus of one sensory quality over another among Ss of varying age groups. Two sets of tests were used. In one set the tests were designed to determine which of the two qualities viz., form and colour gained in dominance while perceiving. In the other set qualities of length and breadth in linear perception formed the subject matter of inquiry. Subjects participating belonged to two age groups—3 to 10 and 20 to 24 years. Dominance of one sensory quality over another was observed and, also, difference in reaction between the age groups.

2. Estimation of Visual Extents Under Variable Conditions.

R. G. CHATTERJEA and RAMANATH KUNDU, Calcutta.

The paper reports the results of experiments on three visual lengths under four variable conditions. The subjects were all students of the university post-graduate, undergraduate and certificate in applied psychology courses numbering twentyfive. The results show that there is significant variations in the magnitude of errors along with the change of visual lengths. The space error due to movement of the variable stimulus length was found to be lesser in magnitude than the error due to position of the stimulus length. The constant error in one presentation of standard length varied widely, from the other two lengths. It appears that trends similar to that obtained in case of time estimation, viz., underestimation and overestimation, may be found in the estimation of visual extents.

3. The effect of different phases of pain and pressure on respiratory system in ... comparison with the normal condition of muscular activity leading to fatigue.

PRABHAT K. MUKHOPADHYAY and A. K. SIRKAR, Calcutta.

The present paper intends to deal with the various natures of pain and pressure showing its effects on the changes in the respirations. It further shows the probable difference or similarity in the nature of the respiratory curves between the different stages of muscular work in terms of the different modalities of pain and pressure. The experiment is conducted upon 10 male students of the post-graduate classes. First, a respiration curves has been taken under normal condition. Then by Ergograph, a work-curve upto fatigue has been taken and simultaneously the pneumographic curve has also been recorded. Then with the modified form of the Von Frey aesthesiometer 4 equal increments of painful stimuli have been applied on the localised skin surface on the hands of the subjects and during this condition pneumograhic records have also been recorded. Finally with a specially prepared vice, gradient pressure with equally spaced hierarchical intensities in 4 differences have been applied on a localised area of the forearm and palms of the subjects. Here, the pneumographic records have also been taken simultaneously. Then from the pneumographic records i/(i+e) ratios with their means and sum of the square deviations for each phase of experimental variations have been calculated. For each phase applying Fisher's 't' the statistical significance of the difference between the i/(i+e) ratios in work curves and those of pressure and pain curves have been tested.

From these experimental and statistical orientation, it has been found out that the respiratory changes in the gradient pain and pressure modalities show marked affinities in the specific phases of work leading upto fatigue.

4. Behaviour of certain mammals towards snakes.

ISHAR PRAKASH, Jaipur.

A large number of live mammals and snakes were being collected by us during a Project, 'Study of desert vertebrates and their role in preserving and spreading the desert conditions', aided by U.N.E.S.C.O. They were kept in large cages—90″ × 30″ × 30″, having sandy bottoms so that the burrowing mammals may tunnel. Occasionally, I had witnessed duels between mammals and snakes in nature as well as in captivity. Since the snakes are the natural enemies of mammals, particularly of rodents ; some experiments were conducted to study the reaction of hedgehogs, mongoose, Desert fox and gerbilles toward different species of snakes (*Eryx, Echis, Python, Zamenis, Coluber* and *Bungarus*).

Reaction of mammals as shown toward snakes can be classified in two phases. 1. Alarm : As soon as the mammal perceives the presence of the serpent, it is immediately alarmed and behaves in different ways. 2. Panic : The stimuli is intensified to the extent as to produce hasty movements, sometimes resulting into attack on the snake.

The paper also deals with the factors influencing the reactions and behaviour such as role of scent, sight, size of the snake etc.

5. Gustatory Perception of mentally deficients.

SUBIMAL DEB, Calcutta.

The pivot of interest around which this experimentation was performed was to see if there is any speciality in gustatory perception of the mentally deficients.

30 candidates, all vagrants and untrained, were chosen for the purpose from a reputed Calcutta Home for Mentally Deficients and handicapped children. They were divided into 3 groups, each consisting of 10, corresponding to Tredgold's three types of mental deficiencies viz., Morons, Imbeciles and Idiots. 4 solutions (strength N/100) were prepared out of sugar, salt, chilli and Tamarind and administered one by one upon all the 30 candidates with their eyes blindfolded. Moron group did best in distinguishing all the 4 types of tastes. Next, the same experiment was performed but the subjects were allowed to see the operation. There was improvement of the result in the latter case.

In the second part of the experiment, the author tried to determine if the native perceptual faculty of the mentally deficients could be improved by training. Training was imparted for 12 weeks. Improvement was marked. Then the improved group had been isolated including the 10-idiots who were, however, shown no evidence of improvement after 12 weeks of training. Four special types of soup with those 4-stuffs but varying in proportions were prepared. After administration of which the result obtained is presented below :

(i) Morons have definite gustatory perception of the following stuff Sugar, Salt, Chilli and Tamarind.
(ii) Less thon 50% of the Imbeciles have native gustatory perception of the said stuffs.
(iii) Idiots have no gustatory perception.

6. A case of addiction without drug.

N. N. CHATTERJEE, Calcutta.

In drug addition we often find tendency towards obsession and similarly in obsessions also we find the mechanism of drug addition though addiction is not actually developed. In this paper a case of obsessions where unconscious phantasies showed tendencies towards forming the symptom of drug addiction but ended in a compulsion is discussed and the mechanism of symptom formation is analysed.

7. Re-scoring as an aid to typical revisions of personality questionnaires.

S. JALOTA, Banaras.

The technique for preparing valid and reliable personality questionnaires often implies a rejection, and occasionally an addition, of several items. The typical revision consists in the rejection of some proved unsuitable items. In such cases, the data for the original study can be utilised through rescoring with a fresh set of keys. The *rescored data* could then be used, (i) for cross-validation purposes, (ii) for increasing N for the revised norms.

While working with the Hindi version of the IPAT 16 PF, we found it necessary to reject some 20% (or 40 times) of the original version (*Vyaktitva ki Janch* —33-55), on the basis of poor factor discrimination, as indicated by *negative* or *near-zero* phi-coefficients. We obtained the revised version (Vyaktitva ki khodashanshi *Janch*—35-56) and got data from 200 persons on both the forms during 1956-57. Later we re-scored an earlier group of some 200 persons, and we found that the CR_0 for the differences between the means for the 32 sets of factor scores was insignificant for 27, and significant at 5% level for 2, at 1% level for 1, and at. 1% level for 2 only. The significant differences are in different factors of the two forms. We think this would largely justify our pooling together of these sets of data, and for obtaining practical norms from N=400. Such a course seems both economical and advantageous, as the two sets have proved to be homogeneous.

8. Item analysis of "Group Intelligence Test" on higher group.

SUBIMAL DEB, Calcutta.

This paper is a part of the author's scheme of "Standardisation of Group Intelligence Test". This Group Intelligence Test was designed out of some special items from the L & M forms of the well renowned Terman and Merrill Test. It was administered upon 100 Arts & Science graduates who sought enrolment in the I.A.S. coaching course organised by the Calcutta University. 20 items of the test were distributed over 60 sub-items each of which yielded an independent test parameter. Scores were given as 1 for each correct answer and O for each omision or incorrect answer. The procedure described by Gulliksen in his "Theory of Mental Tests" Ch. 21 has been mainly employed in treating these data. Although there are items which show reliability index $r_{xg} s_g$ to be 0 or otherwise poor, the author is not rigid to conclude anything on the basis of it. In future it may be verified whether there may lie any discrepency in reliability in higher and lower group sampling. But at present, it is evident from the result that there are certain items which are contra-indicatory to be accommodated into the group application.

9. A comparison of attitude scores on some politico-economic issues between two samples of college students after an interval of four years.

RADHANATH RATH, Cuttack.

The purpose of this investigation was to assess the attitudes of some college students of Orissa towards sixteen Politico-economic issues during the year 1956 and compare the distribution of attitude scores with those of another group studied in 1952. Both the samples were drawn from the same institutions though the populations were different. About 450 students participated in this investigation. The distribution of test scores on a five point scale was calculated in percentages and its significance examined by the help of Ch-sq. test. The distribution of attitude scores did give an indication of the trend of attitudes of the present sample because the distribution of scores on a five point scale was not proved to be random. Then the distribution of both the samples towards each issue were compared and the significance of their difference was also similarly tested. The difference between the two sets of scores obtained from the two samples after an interval of four years was statistically significant, so the trends of two samples were proved to be different from each other.

There had been a good consistency in the shift of attitudes of the present sample. For example as there had been a shift of opinion in favour of Russia there had also been a corresponding change against the United States of America. Similar shifts in trend had been observed with regard to others.

10. Study in stereotypes of college freshmen and service holders (of Orissa) towards their own nationality and four other foreign groups.

RADHANATH RATH, Cuttack.

The purpose of this investigation was to assess the stereotypes of 100 college freshmen and 100 service holders of Orissa towards their own nationality namely 'Indian' and four other out-groups namely the American, British, Russia and Chinese. All the subjects were the genuine inhabitants of the state. A list of 60 adjectives was prepared after the necessary pre-test.

The scores of the student and the service holder groups were kept separately for comparison. Attributes checked by at least 20% of the either group were selected for discussion in this paper. It was interesting to note that the subjects chose the largest number of derogatory traits for the Americans and British whereas they chose only two bad traits out of 16 selected for the Russians and not a single such trait for the Chinese for whom there were 15 good attributes. For the we-group they selected 18 good and 5 bad traits.

The rank correlations between the two sets of scores (i.e. students and service holders) in relation to these 5 reference groups were highly significant. The mean scores of the service holders for each reference group were usually higher but the mean differences were not significant. This means that though the samples belonged to two dissimilar populations yet they very closely agreed in choosing the attributes for these groups. The results might suggest that the traits which had been selected by the two groups were perhaps the commonly hold attributes for these groups in this region.

11. Study of Aggressive Attitudes of three caste groups.

R. RATH & N. C. SIRCAR, Cuttack.

The purpose of this investigation is to study the aggressive attitudes of upper and lower caste groups towards each other. The upper caste group includes I. Brahmins—which is a homogeneous group, II. Non-Brahmins—which is a heterogeneous group and III. Backward Castes—also a heterogeneous group. Each of these groups have been further subdivided into two sub-groups viz. (a) Students and (b) Non-students or out-siders, in-order-to see if there is any difference between the sub-groups due to the difference in age and worldly experience.

In a situational test form designed to study the aggressive attitudes of upper and lower caste groups opinions are collected from 180 subjects of which 90 are students and 90 are outsiders residing in the City of Cuttack. The following problems are investigated and conclusions are established after proper statistical analysis of the data.

1. The reliability of the Situational Test Form was statistically determined to be significant and dependable and this test is proved to be effective in the three caste groups viz. I. the Brahmin, II. the Non-Brahmin and III. the Backward Castes.
2. Across situations each group is compared with the other in-order-to know if there is any significant difference between them and it is observed that there is significant difference between the Brahmins and the Backward Castes in the distribution of their responses across situations. No such significant differences are seen between the Brahmin and the Non-Brahmin groups and in the Non-Brahmin and the Backward Caste groups.
3. When each group is splitted into two sub-groups viz. students and non-students this test also proved effective in the sub-groups except in the events C & E where the students of the Backward Caste group are distributed randomly.
4. When the differences between sub-groups within each group is tested it is determined that in the Brahmin group only there are significant differences in the distribution of responses between the students and the non-students and in other groups they are distributed randomly.
5. The extent of consistency of responses between situations is then tested and it is observed that only in a few cases there are consistency wherefrom we cannot arrive at any conclusions unless further investigations are made to know the actual nature of these systematic processes.

12. Men in distress.

V. K. KOTHURKAR, Poona.

The paper tries to analyse the interview records of 100 famine stricken men in an attempt to study their feeling and attitude patterns as they faced the famine in Maharashtra during the year 1952-53. The method used in collecting the data was of intensive, individual interviews. The interview records were rated on the dimensions of anxiety, fatalism and extrapunitive aggression on three point scales of zero, 1 and 2. The mean ratings are : Fatalism—1·2; anxiety—1·1; and extrapunitive aggression—0·4. Break-downs according to age, literacy and possession of land do not yield significant differences. The frequencies of expressions of attitudes like anxiety, resignation and surrender, family and group cohesion, feelings of degradation and superfluousness etc. were counted and recorded in a frequency table. The tabulated results are given. The prevailing attitude pattern was one of pervasive anxiety, fatalism, absence of hostile feelings, social cohesion, endurance and fortitude and great frustration tolerance. Comparative data from persons in more propitious circumstances is given.

13. A study of influence of reference group and grouping according to performance quartiles on aspiration level.

SANTIMOY GOSWAMI, Kharagpur.

The object of the present study is to show the influence of (1) reference group and (2) grouping according to performance quartiles on the aspiration level.

Four groups of first year I. I. T. students were studied. Each group contained eleven students. All of them were required to cancel alphabets B, K, and U in a cancellation test. But before doing so the second group was informed that the post-doctoral fellows obtained the score 125 by taking the same test; the third group that 125 was the score made by another group of first year I. I. T. students; and the fourth group that the score of industrial workers was 125. Now they were asked how well they expected to do. The members of the first group were only requested to write their expected score before taking the test. No spurious information was given to them. Lastly, all students (N = 44) were divided according to performance quartiles.

The following observations were made : (1) the higher group lowered the aspiration level; (2) the equally qualified group markedly diminished the goal discrepancy value; and (3) the lower group raised the aspiration level. Moreover, it appeared that the efficient performers were low and the poor performers were very high in setting their goals.

14. Study habits and achievement.

K. K. JAMUAR, Patna.

An attempt has been made to investigate differences in the study habits of high achieving and low achieving College students. The investigation started with Questionnaire dealing with the habits of 200 college students with regard to their study. The results throw some light on the differences that exist in the study habits of high achieving and low achieving pupils. Possible relationships between study habits and achievement have been discussed. It has been suggested that achievement can be predicted by measuring the study habits and intelligence of pupils.

The present investigation, further, seems to be useful as underlining the need for guidance. Study habits of the pupils may be checked and proper guidance may be given to them so that undesirable habits may be eliminated and desirable ones inculcated to improve their achievement.

15. Opinion survey of the Criminality of an Act & Factors Motivating Criminal Acts.

A. N. DEB, Allahabad.

There is often a difference of opinion on these issues like, what are the degree of offensiveness of different criminal acts or the relative influencing factors behind these acts. A statistical pooling of opinion of different group of persons has been attempted here. Ten factors have been carefully selected for each set and opinion obtained by ranking them according to their degree of offensiveness or criminality. Also another set of ten motivating factors were ranked in relation to their importance in influencing crimes.

A fair amount of data has been collected from Students, Lawyers, Teachers, Office Assistants and some Commissioned Officers of the Armed Forces. In all 275 Questionnaire Forms have been obtained.

Act against the society and social welfare has been considered as the most offensive type of crime. Violation of law and order and acts against women and children comes next in order. The groups do not consider that printing of nude pictures and publishing sex appealing literatures as a crime more serious than the items here on the list, like perverted sexual acts, prostitution, suicide, act against God etc.

No one considers that crime is motivated by evil spirits. There is varying emphasis on the factors like bad surroundings, disordered home conditions, maldeveloped personality etc.

16. Allport-Vernon's Study of Values in Indian Situation.

K. RAY-CHOWDHURY, Aligarh.

In 1956 ten post-graduate students worked under the initiative of the present writer on Allport-Vernon's Study of Values (Old Form) and procured ten good samples of about 600 graduate college students (few were undergraduates) from different course subjects taught in the Colleges at Aligarh, affiliated to Muslim University and Agra University. The purpose of the investigation was to (i) find out the norms of the Indian Students for a comparative study of national differences as indicated by the norms obtained from the College Students with the Scale in U.S.A. and U.K., (ii) study the reliability of the items.

Here in this paper a report is being made about two investigations carried out by Raj K. Ojha on a sample of 50 graduate teachers under training for L.T. Diploma in the D. S. College, and by Jacob Joseph on a sample of 60 undergraduate students of the M.U. studying for B. Eng. Degree.

Ojha's sample showed not very poor consistency in different values except the Social category (R = ·67), suggesting that we, the Indian workers, should not throw away all the English tests because their origin is in the West. Of course, Joseph's sample did not show much consistency. The internal consistency was calculated by the Split-half reliability technique.

17. Interests in Amusements and its relation to Personality types.

R. G. CHATTERJEA and SASADHAR BANERJEE, Calcutta.

Various workers in the field of vocational psychology have assessed interest in its manifold dimensions. In the present study, interest has been treated from two aspects only—amusement and personality types in other persons. Amusements in various spheres such as movies, sports, dancing, travelling etc. have been considered and some twentyfour items are in the list. There are ten types of personality patterns. The items are to be judged on four categories indicated by the alphabets 'A', 'B', 'C' and 'D' corresponding to "most like", "like", "dislike" and "most dislike". Percentage preference of each item in general as well as when classified on the basis of age, education and sex differences shows striking features. The subjects—arts and science students in the age range 17 to 25 years of both sexes—were drawn from different Calcutta colleges. As an amusement, 'travelling in railways' is preferred by 92% while 'reading' is disliked by 62% of the students in general. 'Likes' and 'dislikes' appear to differ when considered on the basis of sex, in that, 96% of the male students like 'cricket' and 'football' while their opposite partners like 'movies' most, while the male students have strong aversion to 'gambling', the females dislike 'reading'. But preferring personality types, these groups appear to agree in their likes and dislikes. Similar trends are found when likes and dislikes are considered on the basis of educational groups. 'Travelling in railways' is the common liking in the arts and science students. The science students differ from the arts students in that, the former have an aversion to 'gambling' while the latter dislike 'reading'. The percentage preference in personality types too, follow similar trends.

18. Abilities required for Engineering Profession and their relative importance.

MAYA DEB, Calcutta.

Need for implementation of selection procedure is more pressing, as the complexity of the specialised vocations are growing day by day. M. S. Viteles opines that job or occupational analysis is an essential pre-requisite in case of vocational selection or vocational guidance. Occupational analysis consists of two parts: (i) Job analysis and (ii) Man analysis.

Man analysis includes collection of data regarding the necessary and desired characteristics of the individuals to be a successful worker.

In the present investigation attempts are made to measure the degree of abilities necessary for being successful in the engineering professions. Likert's Scaling Method is used for the purpose and weight for each ability is calculated. From the total weights the abilities required for engineers are arranged in order of their relative importance.

19. An investigation into the choice of 'Profession', 'Activities', and 'College subjects'.

R. G. CHATTERJEA and SASADHAR BANERJEE, Calcutta.

An attempt is made in this paper to show the results of a study on interest in its three dimensions. Students, both male and female of various educational standards in the age-range of 17 to 41 years were required to express their choice of occupation, activities and college subjects on four categories. The categories were defined as "most like", "like", "dislike" and "most dislike" denoted by the letters 'A', 'B', 'C' and 'D' respectively. Nineteen occupations, ten activities and eighteen college subjects only were considered in the present study. The percentage preference of male and female students were alike in certain cases though differences were none the less meagre. Students in the lower age-group (17-18 years) prefer occupation of teacher and physician instead of banking, salesmanship etc. though liking for college subjects suitable for such a choice is not obtained. Interest in 'literature' is common to both male and female students irrespective of age-groups. Even the science students appear to like the college subject headed 'literature'. Film acting as an occupation is liked by 72 per cent of the male students while 64 per cent of the female students have indicated their dislike for the profession. A common dislike in occupational interest is that of a clerical job. Similarly aversion to the college subject—commerce, is found in almost all the cases.

In cases of activities, nearly cent per cent of the subjects have denoted their liking for 'helping others'. 'Sewing' and 'cooking' as activities are disliked by the majority of the cases studied irrespective of age, education and sex differences.

20. Objectless or self-existent Joy of Indian Psychology.

INDRA SEN, Pondicherry.

Emotions are, by a general psychological characterisation, recognised as effusions of feelings or a stirred-up state of the psycho-physical organism, essentially impulsive, caused and occasioned by an object or situation and as involving a pre-existent conation or tendency. A few of these are considered as primary and the rest as derivative.

The place of emotions in the dynamics of personality is very important, but a scientific investigation of them has been found to be very difficult. Introspection has been affirmed as, for a direct study, the only method, which can yield an appreciation of the emotional qualities and their essential conditions, but it has yet to be duly cultivated and systematically applied to this problem.

Indian Psychology offers in this connection, in particular, one judgment which is extremely challenging. It says that truly primary there is only one emotion and that is the objectless or self-existent joy experienced under rather special circumstances. Mind is to practically all Indian systems of thought and yoga a form of consciousness, *Bahirmukh,* outward-directed and essentially concerned with the environment. But besides it, there is a self-existent consciousness, called the *Atma, Purusha,* etc., which is the central fact of personality. Joy is one of the essential attributes of this fact. The basic emotion is affirmed to be this joy and all the normal emotions as derivative.

Contemporary yogic experience holds out some interesting corroborative evidence, which is stated in the paper in some detail.

21 The Psychology of Integral Education of Sri Aurobindo.'

N. K. DAS GUPTA, Santiniketan.

Education, in the past, was *instructive.* Now it is *formative.* The final goal of education now is—the development of the total man, with his personality perfectly integrated. To achieve this end different layers of human personality must be known.

Freud, by his epoch making discovery of the unconscious mind revealed an important aspect of human personality. Jung made further advance by taking a much wider and extensive view of the unconscious mind. But Jung failed to see the extension of our waking consciousness to a higher form, or *Super-consciousness.*

Sri Aurobindo gives a more *wholistic* view in this respect. He affirms the existence of Super-consciousness at the higher end of the ordinary consciousness. According to him man is a being of multiple personalities—physical, vital, mental and Psychical. The Psyche, the central personality, the real *self,* lies practically inactive and hidden and is enveloped by the external sheaths—physical, vital, mental. The three outward personalities are at anarchy, each active in its own turn, as if, there were no unitary organisation among them.

This anarchism shall have to go. There must be complete harmony and perfect homogeniety. This can be done according to Sri Aurobindo by bringing the Psyche to the forefront, giving him the full control of life,—when the body, the vital and the mind, being converted as perfect instruments at the hands of the Psyche, will work in unision.

To achieve this end Sri Aurobindo has formulated his 'Integral Education' which is based on an adequate psychology of human personality, mind and consciousness.

22. A Comparative Study of Hindi Vocabulary of Upper-Middle and Low S.E.S. Children in Delhi Schools.

Miss P. PASRICHA.

Purpose of the study: To investigate

(i) the language skills in Hindi, as revealed through a semi-structured composition on a familiar topic, by the sixth grade children in Delhi Schools.

(ii) The difference, if any, in this skill revealed by the children from high and low socio-economic status groups.

Sample: The sample consisted of:

(i) a group of 48 children studying in the sixth class and coming from the families of factory workers, and

(ii) a group of 49 children from the sixth class of a school in the same locality but catering to the upper-middle socio-economic status group.

The age range of both the groups was the same, from 10 years to 15 years.

No specific selection was made except that the group of factory workers' children did not include any child coming from a different S.E.S. level.

Collection of data: A form of semi-structured composition was evolved and printed. Besides the personal information about the subject, this form gave instructions for the use of this form which were read out to the groups in a set manner.

On this form the children were required to write a free composition of two pages. No other instructions or help was given to them. They were free to write whatever they liked. No time limit was set, but they were limited as far as the space was concerned; they had to confine themselves to the one sheet of paper that was given to them.

Analysis of data: These compositions were then analysed by reading each word and categorizing it under different parts of speech. In doing so the proper names, the repetitions and the wrongly used words were omitted. The argument for this procedure was that all these fail to show the language skill of the child.

A score of one was awarded for each word rightly used.

The means of the two groups on total vocabulary as well as on each part of speech were compared and the difference of means calculated.

Results: The upper-middle socio-economic status group scored consistently higher on each category and all these differences were statistically significant.

Conclusions: As already found in studies done in English language, in Hindi as well the higher S.E.S. affects the language skills of the children. A particular S.E.S. carries with it certain facilities and advantages which affect the language of the child living under its influence.

The culture at home, the language spoken by the parents and the opportunity to move in a particular kind of company and atmosphere is correlated with the language of the child.

The higher socio-economic status families seem to provide these facilities to the children in a better fashion than the lower socio-economic status parents.

SECTION OF ENGINEERING AND METALLURGY

President :—PROF. C. S. GHOSH, M.Sc., S.M., F.N.I., Mem.A.I.E.E.

Abstracts

1. Some characteristics of seepage through pervious foundations.

S. K. ROY, Poona.

Seepage through permeable foundations below an earth dam section is in many cases characterised by a comparatively shallow depth of pervious foundation, possible stratification of the bed material, the likelihood of the horizontal permeability being more than the vertical permeability, and cut-offs not reaching the full depth upto the impervious foundation rock. Seepage reduction factors for different cut-off ratios, are obtained in the idealized solution of Pavlovsky in terms of the Jecobian elliptic functions, for a series of different relative depths of uniform foundation material as well as for the limiting cases of shallow foundation depths, where the potential gradients in the vicinity of the exit are simplified, both for the uniform case, and in the anisotropic case when the horizontal and vertical permeabilities are different. The modifications in potential due to an incomplete cut-off in a uniform field show that the factor defining the rise of potential in terms of the flow intercepted continue to be not far from unity, being 1·80 for 90% cut-off and 3·12 for 99% cut-off, and to that extent a suitably impervious grout curtain spanning the full depth tend to have more importance than an incomplete cut-off. Seepage reduction factors for a two-layer stratified bed with the upper layer more impervious are also considered. Also the potentials in the vicinity of a line of relief wells downstream of the impervious core, which in effect, is a three-dimensional flow problem, are considered which show the localised nature of the effects on the general distribution. Numerical results, and typical distributions are given as relevant aid to design.

2. "A study of the properties of building mortars".

N. K. PATWARDHAN, A. C. BANERJEE, S. S. REHSI, S. P. GARG and SURAJ BHAN, Roorkee.

The purpose of this investigation was (i) to make a wide survey of the physical properties of mortars, and (ii) to find out the extent to which lime can replace cement in building construction.

The present paper covers the studies on two types of sand; two types of limes and two types of pozzolanas. Recommendations are only possible when full data is available. However, from the trend of the results it can be inferred that :—

1. With Ranipur sand, Satna lime gives better strength than Dehra Dun lime in all proportions of the mix.
2. With Jamuna sand, Satna lime gives, in richer mixes, only higher strength than Dehra Dun lime. With leaner mixes, however, Dehra Dun lime seems to show better results.
3. Out of the two pozzolanas commonly used in building construction, the surkhi mortar (1 :2) gives all round better strength than cinder mortar (1 :2).
4. The above conclusions are only tentative,

3. River Jaldhaka Power Development.

Dr. M. DATTA, Calcutta.

The supply of electricity in West Bengal is mainly through Thermal Power Stations. Only about 1·2% of the total power of 546 MW is produced by hydro-electric stations, at Darjeeling and Kurseong. With the establishment of the State Electricity Board, hydrometric survey in the state is being carried out with a view to exploitation of the water power resources of the state. On the basis of preliminary investigations the Jaldhaka river in the north of West Bengal has been found to be suitable for power development purposes. The programme in its final stage visualises a head of 1000 feet and the present development is expected to be about 20 MW at 60% load factor. There are also other sites in the same area with a potential capacity of 100 MW and an annual energy output of 700 million kWhrs. The paper discusses some of the details of the Jaldhaka project.

4. Commissioning of Transformer.

R. N. GANGULY, Calcutta.

The problems associated with the commissioning of transformer are diverse and numerous. The main object of commissioning is to prove that the equipment has been properly installed to function correctly. The commissioning of a transformer necessitates a thorough understanding of many practical and theoretical considerations. Although most parts of the equipment will have been workstested, it is not until the gear is installed on site that it is completely erected and put together. Careful preparation, detailed checking of the information available during test, application of appropriate adjustments to any anticipated troubles encountered during commissioning of the transformer will result in successful operation and troublefree maintenance for the future.

The question therefore usually arises as to which of the characteristics are to be checked on site and which are to be taken as correct, particularly in a country like ours where facilities for elaborate and extensive test gears are limited.

On the basis of experience gathered and datas collected during the commissioning of several power and distribution transformers in this country a systematic procedure has been laid down in this paper for carrying out commissioning tests with the help of simple instruments and apparatus. The paper also describes the application and functions of modern protective fittings of the transformer and the methods that are to be adopted to check their performances.

5. "Rectifier operated wattmeter and Power Factor Meter".

J. K. CHOUDHURY and S. K. GHOSH, Calcutta.

The paper describes the design and construction of a Wattmeter and a Power Factor Meter employing a phase-sensitive Rectifier Bridge. Copper oxide rectifiers have been used as the bridge elements and the fundamental arrangement is a half-wave version of the conventional modulator bridge. In both the Wattmeter and the Power factor Meter there are two input voltages to a phase-sensitive rectifier bridge, one voltage being proportional to the line e.m.f. and the other to the line current; at the output of the bridge circuit a uni-directional voltage is obtained whose magnitude is proportional to the product of one of these two voltage (—either of the two may be conveniently selected) and the cosine of the angle between the two voltages. This output voltage may be indicated by a permanent magnet moving coil instrument. The rectifier operated Wattmeter and Power Factor meter are sensitive, light in weight and consume much lower power than corresponding instruments of other types.

6. Some investigations on Dielectric Rod Aerial.

(Mrs.) R. CHATTERJEE and S. K. CHATTERJEE, Bangalore.

Two different expressions[1, 2] for the radiation pattern of a circular dielectric rod aerial excited in the HE_{11} mode have been derived. In one case the rod has been assumed to carry fictitious electric and magnetic current sheets, in terms of which the electric and magnetic vector potentials A^E and A^H are expressed. The field intensity at any distant point is then found from the generalised expression of field intensity involving A^E and A^H. In the other case, the rod has been assumed to be an assemblage of secondary radiators distributed over the surface of the rod in all possible planes. Experimental[3, 4] verification of the theories at 3·2 cms. wavelengths for perspex rods of length varying from $2\lambda_0$ to $10\lambda_0$ and diameter varying from $0{\cdot}4\lambda_0$ to $0{\cdot}8\lambda_0$ leads to the following conclusions.

1. The positions of maxima and minima for the radiation pattern in the $\Phi=0°$ plane agree fairly well even upto the 16th minor lobe as obtained by the two theories and experiment.

2. The ratio of the intensities of different minor lobes with respect to the major lobe as obtained by experiment in the $\Phi=0°$ plane agrees better with that obtained by the first theory than the second theory.

3. The measured value of beam width of the major lobe in the $\Phi=0°$ plane shows fair agreement with those obtained by the two theories.

The beam width predicted by the first theory in the $\Phi=0°$ plane differs from that in the $\Phi=90°$ plane. But this difference is not revealed by the second theory. The difference between the two theories is considered to be due to the following fact[5]. The first theory which is based on Schelkunoff's Equivalence principle is a vector formulation, whereas, the second theory which is based on Huyghen's principle is essentially a scalar formulation. As the HE_{11} mode is asymmetric, the beam width in different planes will differ. It is concluded that the first theory based on Schelkunoff's Equivalence principle is more correct than the second theory based on Huyghen's principle.

7. Propagation of surface waves along a Cylindrical Conductor.

S. K. CHATTERJEE, Bangalore.

The following investigations on the propagation of surface wave (E_0 mode) on a single wire at 3·2 cms. wave length have been made. (i) Field distributions along and round the wire, (ii) calculation of longitudinal and transverse impedance, (iii) matching of the transmission line carrying the surface wave, (iv) radial field decay, (v) energy distribution in the radial direction. The results on radial field measurements indicate fair agreement with results predicted by the theory

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(Mrs.) R. Chatterjee, S. K. Chatterjee : Jour. Ind. Inst. Sci. (1956), 38, 93.
(Mrs.) R. Chatterjee, S. K. Chatterjee : Jour. Ind. Inst. Sci. (1957), 39, 134.
B. Rama Rao, (Mrs.) R. Chatterjee, S. K. Chatterjee : Jour. Ind. Inst. Sci. (under publication).
(Mrs.) R. Chatterjee : Electrotechnologist (under publication).
(Mrs.) R. Chatterjee, S. K. Chatterjee : Jour. Telecomm. Engrs. (under publication).

of surface wave transmission. The decay coefficient[1] for the radial field is 14·0 m. Three different types of terminations, viz. (i) wooden tapered termination of different sizes, (ii) absorbing materials placed at the receiving end of the line, (iii) wooden termination with graphite coated fins have been attempted to match the line. The results of standing wave measurements with pick up probe placed in the E_z and E_r orientations at different radial distances from the transmission line exhibit the superiority of a tapered wooden termination fixed with cardboard fins sprayed with graphite as a matching device[2]. A study of the percentages of the wire shows that the experimental value of the field shrinkage is more than predicted by the theory. The reasons for this difference is discussed and justified[1].

8. A High Frequency Junction Transistor Oscillator.

B. M. BANERJEE and K. S. PATEL, Calcutta.

In contrast with a vacuum tube, the transit times of charge carriers in a junction transistor are quite large. This introduces a phase lag in the collector current with respect to the emitter current that is appreciable even at frequencies of the order of 100 Kc/s. The oscillation frequency of a self oscillator therefore tends to be slightly different from the resonant frequency of the tank circuit, as the oscillator tries to compensate for this phase lag by a phase lead in the tank circuit. The tank circuit therefore places a reactive load on the collector which reduces the output obtainable. At still higher frequencies, this phase lag may be so great that oscillations may stop, although the gain in terms of power output obtainable to the driving power needed still remains sensibly greater than unity. In the circuit developed, these difficulties were overcome by introducing a compensating phase lead by a high pass filter section. This compensates also an unavoidable phase lag between the tank voltage and the input current. It has been found that the upper limit of oscillation can be considerably increased. Besides, the expectation of a higher output has also been substantiated.

9. Electret as transistor.

Dr. C. S. BHATNAGAR, Bhopal.

An electret in the form of a pyramid is prepared by polarising the carnauba wax by 300 volts. All the four sides of the pyramid and the base of the pyramid form electrodes. If the flow of current is observed between any two opposite sides of this pyramid electret, a rectification is observed i.e., a decrease, in current, is observed if the potential is reversed. This is found to increase if the opposite pair is made negative with respect to earth and the application of positive potential on this pair decreases the rectification. A still more increase in rectification is observed if the base of the pyramid and any one of the terminal is used. All the possible combinations are tried and it is observed that there is a definite rectification and it is found to increase, if the opposite pair of the terminals are made negative with respect to earth, while an application of positive potential decreases this. The use of this as transistor is suggested.

10. Linear Frequency Discriminator for Sub-Carrier Frequencies.

P. KUNDU, Kharagpur.

F. M. sub-carrier technique is finding increasing applications in the field of communication, control and measurement requiring carrier as low as few hundred cycles having frequency deviation as high as 20% of the mean carrier. Linearity of demodulation and stability of performance are two essential characteristics which are quite difficult to realise with the conventional systems at lower frequencies.

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[1] S. K. Chatterjee, P. Madhavan : Jour. Ind. Inst. Sci. (1955), 37, 200.
[2] S. N. Contractor, S. K. Chatterjee : Jour. Ind. Inst. Sci. (1957), 39, 52.

A method based on the principle of phase discrimination is described here, in which the signal grid of a pentagrid mixer stage is fed by an f.m. input signal of proper frequency and magnitude through an all pass constant gain phase shifting network, and the oscillator grid through a constant gain amplifier, when a demodulated output is obtained at the l.f. filter of the plate load of the mixer. A theoretical relationship for optimum operating condition for an essentially linear output frequency characteristics and an expression for the degree of linearity about this point with the frequency deviation, have been developed for a phase shift network of a particular response. The experimental results taken over a frequency range of about 100 Kc/s. have been found to agree closely with the theoretical observations. The response remains linear within 0·5% giving an output of 0·8 volts for a frequency deviation of 25% of the mean carrier while the stability of the output remains within the drift that may be allowed due to the frequency stability of the input signal source.

The method described herein, has further been utilised in developing a phase angle meter for reading directly an angle between 0 to ±180° on a calibrated meter with an accuracy of ±1% over a frequency range of 100 Kc/s.

11. A Technique for Speeding up the Operation of the E.I.T. decade Counter-tube.

R. PARSHAD and S. K. SINGH, New Delhi.

The E. I. T. decade counter tube is slower than the usual hard-tube decade derived from a four-stage binary counter. The slowness in counting is due to the necessity of charging of the associated anode capacitances of the tube through a high resistor. This paper introduces a technique by which the charging of the capacitances is speeded up by introducing an alternative charging path via a rectifier, extra to that of the anode load resistor. This new charging path remains cut-off until the count shifts from nine to zero. At this count, the path becomes conducting, and effectively the anode load resistor gets paralleled by a load resistor of 22K ohms, resulting in increase of speed of counting.

12. Multi-channel Sequential Switching by means of Binary scalers in Cascade.

R. PARSHAD and S. K. SINGH, New Delhi.

A new technique is described of obtaining multi-channel commutation from binary scalers in cascade. Diodegating techniques are employed to obtain switching pulses from binary counting. The pulses have steep leading and trailing edges and are negative-going in polarity. For each switching channel, the diodegating arrangement is a diode assembly whose anodes are singly connected to plates of different stages of the counter, and whose cathodes, tied together, are returned through a resistor to the plate of the remaining binary stage. When for a particular counting, binary tubes feeding the diode assembly are conducting, the plate-potentials are low, and a negative-going pulse is obtained at the common cathode.

By using one extra diode for each diode-assembly the base of the switching pulse can be modulated with an audio signal.

13. Selection of tubes and circuit elements for the design of Electronic Wattmeters.

S. S. BANERJEE and H. SARKAR, Banaras.

The measurement of power involves the evaluation of the product of current and voltage in a circuit. But as the thermionic valves are voltage operated devices, the current component of the load is first transformed into voltage by passing it through a small resistance placed in series with the load and the sum and difference between this voltage and that across the load are applied to the grids of the two tubes connected as a balanced modulator. Multiplication of two voltages are possible in a mixer circuit if it is biased to operate over a non-linear portion of the transfer characteristic. An equation has been developed to show that the d.c. value of the variational increment of the output current flowing in response to a sinusoidal input voltage applied to the grid of a valve when working as a perfect squarring element is proportional to the input voltage. This equation shows that in order to obtain linearity between the d.c. increment in plate current and the input voltage the value of the slope of grid bias-transconductance curve should remain constant over the operating region of the valve. As the self-bias form of circuit has been adopted it is essential that the slope should be constant over a wide range to allow for the shift in the quiescent operating point without causing any non-linearity in the meter readings.

Various types of valves have been tested for the above purpose and it has been observed that the double-triode 6SN7 has a constant value of the slope over a small region, while the power pentodes 6F6 and 6K6 have got a constant value of the same over a wide range of grid voltage. Therefore, the valve 6SN7 has been found to be suitable when the power consumed in the load circuit is small. In that case, the change of plate current from its quiescent value is quite small, and consequently, the dynamic shift from the initial grid bias is not much. But when large power is to be measured the power pentode has got a definite superiority over the triode as it can maintain linearity in the meter reading although the quiescent operating point is considerably shifted. With the use of the pentodes it has been possible to increase the frequency range for the wattmeter due to the low capacitance between the anode and control grid which reduces the feed-back sufficiently. Detailed study has also been made for finding the limits of the balancing resistances in the plate and screen grid circuits for proper operation of the wattmeter.

14. On the measurement of horizontal gradient of ionisation with the help of back-scattered radio signals.

S. S. BANERJEE and P. G. SURANGE, Banaras.

It was shown by us in an earlier paper (Science and Culture, 21,750,1956) that if the minimum virtual path length for a wave propogated through the ionosphere is plotted against its frequency, then the $P'_{min}f$ curve so obtained is a straight line, provided the ionosphere is uniform in the horizontal direction. A non-linear $P'_{min}f$ curve however should be obtained for a non-uniform ionosphere, which involves the variation of height, thickness, and critical frequency in the horizontal direction. It has now been found that when only horizontal gradient of ionisation exists in the ionosphere, the $P'_{min}f$ curves do not differ appreciably from straight lines, though the inclination of the lines is different for different magnitudes of the gradient. Further, in the absence of the horizontal gradient of ionisation, the variations in the height and thickness of the layer, may also affect the inclination of the $P'_{min}f$ curve equally. This makes the analysis of the P'_{mi} f curves, obtained from the back-scatter measurements, difficult for the calculation of horizontal gradient of ionisation in the ionosphere. It can however be estimated with fair accuracy when the variations in the height and thickness of the layer with horizontal distance are known.

15. Thermal expansion of the Ionosphere.

S. S. BANERJEE and S. K. SHARMA, Banaras.

Some time back it was suggested by Banerjee and Singh (Nature, 164, 925, 1949) that the disappearance of radio signals from distant transmitting stations in the morning hours after sun rise may be due to the thermal expansion of the F_2—layer of the ionosphere. From the observations on diurnal variations of critical frequency in equitorial belt Appleton (J. Atmos. Terrest. Phys., 5, No. 5-6, 348-51, 1954) has also suggested the occurrence of thermal dilatation of the F_2 region of the ionosphere. Although Martyn (Proc. Roy. Soc. A, 189, 241, 1947) has explained the above mentioned anomalies due to vertical ionic drift under electro-dynamical force resulting in the vertical spread of the ionized layer.

Recently the probable cause of the above anomalies has been studied in details by us in terms of the variations of (1) critical frequency of F_2 layer (2) its semithickness (3) its height of maximum ionization and (4) the collisional frequency of electrons with neutral particles in the layer. It has been shown in the present communication that the variation of the first three parameters can be explained by any of the alternatives mentioned above. But the variation of collisional frequency, which shows a dip before noon, can be explained only due to the thermal expansion of the layer.

16. An Electronic Coder and Decoder for Teleprinter Signals.

J. DAS, Kharagpur.

The teleprinter signal usually consists of a startpulse, five codepulses and a stoppulse. The coding and decoding of the message are done mechanically in modern teleprinters. Electronic circuits have been used here to simulate the functions of the mechanical coder and decoder. In the coder, the letterkey triggers a 50 c/s multivibrator whose output is passed through a channel separator using a chain counter. The individual channel-outputs are gated by the same letter key and the gates either allow a channel pulse to pass to the mixer or not, depending upon the code assigned to the letter to be sent. The multivibrator stops after sending the stop pulse. The mixer output controls a polarised relay which sends the required code signals to the line.

The decoder consists of a similar triggered multivibrator which is actuated by the startpulse and is stopped by the stop pulse. A channel separator produces individual channel pulses, which gate the incoming codepulses in a code selector stage. The code selector recognises the presence or absence of a particular codepulse. The five code pulses are assigned binary codes and are made to trigger individual multivibrators which produce 16, 8, 4, 2, 1 pulses respectively. The ultimate symbol is recognised from the total number of pulses generated by the multivibrators. In the final stage, another chain counter is used and the last output from the chaincounter is made to operate the typebar-electromagnet. Miniature gastriodes have been used in all counting and selector circuits. With a stable multivibrator, the ideal margin of the decoder is 50%.

17. Acoustics of the Central Building Research Institute Auditorium.

Dr. C. G. BALACHANDRAN, Roorkee.

This paper describes the theoretical and experimental analyses of the acoustical behaviour of the above auditorium. Reverberation times for the empty hall were calculated and measured at six sound frequencies viz. 125, 250, 500, 1000, 2000 and 4000 cycles per second. The calculations were made using the published values of absorption coefficients of the materials in the auditorium. The reverberation times were determined experimentally by recording the sound decay in the hall with a high speed level recorder. The calculated times are 3·11, 2·48, 1·59, 1·21, 1·25 and 1·28 seconds at the above frequencies and the measured times are 1·3, 1·5, 1·5, 1·6, 1·4, and 1·2 seconds. There is a fairly good agreement between the calculated and measured reverberation times on the high frequency side. The values of the calculated reverberation times are higher than the measured ones at low frequencies. This may be explained if one takes into account the absorption resulting from the air enclosed behind the plywood panels on the walls and the celotex boards on the ceiling. There is another mode of vibration in the hall with a decay time of 3·1 secs. at 125 c.p.s. and 2·1 secs. at 250 c.p.s. This is probably due to the reverberation in the ducts in the ceiling which are not lined with absorbent materials.

18. Recovery of Titanium as Chloride from the 'Red Mud'.

DIPAK GUHA & H. N. DAS GUPTA, Dhanbad.

The extraction of metallic titanium in a state of reasonable purity is beset with manifold difficulties. The chief amongst them is its tendency to form brittle interstitial compounds with even traces of carbon, oxygen, nitrogen, silicon, etc. The halides of titanium are now being considered suitable for the production of metallic titanium. The methods involve (1) reduction by different metals (Hunter J. Amer. Chem. Soc., 1910, 32, 330; Kroll, Trans. Electro-Chem. Soc., 1937, 78, 35), (ii) thermal dissociation and (iii) disproportionation of the halides. Besides, the chlorinated derivative is becoming increasingly popular in industry as it has proved to be a suitable source of titania of pigment grade. Various techniques have, therefore, been introduced for the preparation of iron free titanic chloride or other halides. The red mud left after the extraction of pure alumina from bauxite of Lohardaga mines contains 27-28% of titania. This, therefore, constitutes a cheap source of titania. It has been found feasible to prepare pure titanic chloride from this mud by subjecting it to a combination of techniques involving reduction, followed by separation of iron and titanium as halides. The vapour phase hydrolysis of the titanic chloride yields pigment grade titania.

19. Batch grinding of cement clinker.

S. P. MUKHERJEE and S. K. NANDI, Kharagpur.

Batch grinding of cement clinker has been done in a 8″ × 8—1/8″ steel ball mill with a view to studying the effects of different variables on grinding efficiency. Mill performance has been assessed by the total new surface created, as determined from differential screen analysis.

The following table shows the variables studied, the range of variation and the most optimum condition for obtaining the maximum surface.

	Variable	*Range*	*Optimum condition for maximum surface.*
1.	Time of grinding	5 minutes — 6 hrs.	60 minutes
2.	Mill speed	22 % — 83% of Critical speed	63 % critical speed
3.	Feed size	0·2505 cm — 0·7938 cm	0·3969 cm or 0·02 of Mill dia.
4.	Feed quantity	150 — 2000 gms	2000 gms or feed volume occupying 21% of Mill volume.
5.	Ball size	1/2″—2″ dia. steel balls.	1″ balls or 6·4 times the feed size.
6.	Ball load	100-250 Nos.	200 balls or ball volume occupying 49 % of Mill volume.

Further work on closed circuit grinding of cement clinker is in progress.

20. Beneficiation of Graphitic Ore from Gobag, Purulia.

K. K. MAJUMDAR, Dhanbad.

Low grade graphitic ore (ash 89·48 p.c.) from Gobag in the district of Purulia, W. Bengal, was subjected to laboratory tests to study its amenability to flotation. The ore was micaceous graphitic schist containing quartz. The associated minerals were highly disseminated. The flotation reagents were kerosine, cresylic acid and sometimes sodium silicate. The pH of the pulp was varied from 5·0 to 9·2. One special feature of this ore was that very high p.c. of recovery, over 93 p.c., was possible even after reflotation of the concentrate. With very finely ground ore (76·64 p.c. minus 200 mesh), it was possible to obtain a concentrate after reflotation with only kerosine and cresylic acid in natural water (pH 6·8) with 17·56 p.c. ash and 94·17 p.c. recovery. This grade has excellent staining power and is free from gritty materials. It compares very favourably with Korean graphite (carbon 81·83 p.c.) and can be used in the pencil industry.

21. Pilot Plant Studies for the Production of Synthetic Fuel by the Fischer-Tropsch Process.

G. S. DAVIS, S. N. SARKAR & A. N. ROY.

A pilot plant for the production of synthetic fuel from coal by the Fischer-Tropsch process is under construction. In order to evaluate activity of iron and cobalt catalysts and to determine the proper operating conditions on a smaller scale two single-tube pilot reactors, each with 4·5 litres catalyst space, have been installed and put into operation.

The synthesis gas, a mixture of CO and H_2, was obtained by gasification of coke in a water-gas plant. The raw gas was purified from injurious impurities such as dust, tar, gumformers, H_2S and organic sulphur compounds by passing through a series of purification towers containing iron oxide mass, activated carbon and hot soda-iron material.

The iron and cobalt catalysts, prepared by the precipitation process, had the following compositions : Fe-Cu-CaO-MgO-K_2O (83 : 8 : 3 : 5 : 1) and Co-ThO_2-MgO-Kieselguhr (100 :5 :5 :200). These were reduced with H_2N_2(20%) mixture for two hours at 350°-400°C using a space velocity of 3000 per hour.

Synthesis over iron catalyst was studied at pressures of 100-150 lbs./sq. inch and temperatures of 265°-270°C using H_2:CO ratio of 1·2 and a space velocity of 110 per hour. Conversion of 65-70 percent of synthesis gas was attained. The product obtained mainly consisted of wax, diesel oil, light oil and some oxygenated compounds.

Synthesis over cobalt catalyst was studied at atmospheric pressure and 185°C by varying H_2/CO ratio from 2 to 1·2 and space velocity of 70 to 125 per hour. Under optimum conditions conversion of 65-70 percent of synthesis gas was obtained. Wax, diesel oil, light oil and hydrocarbon gases were the main products of reaction.

22. Prevention of corrosion of steel by paints.

A. K. CHOUDHURY & S. C. SHOME, Calcutta.

The chromates, molybdates and tungstates of zinc and lead are employed as pigments and the paints are prepared by mixing the pigments separately with linseed oil. The steel specimens coated with the paints are partially immersed in salt solutions and the corrosion behaviour of the painted steel is investigated by the measurement of electrode potentials.

The paint coatings of zinc chromate (basic) and zinc molybdate prevent the corrosion of underlying steel satisfactorily—the former produces an impervious film on the steel and the latter protects the metallic surface probably by both chemical and mechanical effects. The zinc tungstate paint behaves similarly as the zinc molybdate coating; its protective value is, however, slightly less than that of the zinc molybdate. The lead paints afford protection to steel at the early stages, but gradually break down when the coatings remain exposed to the corrosive liquid over longer periods.

23. Determination of Nitrogen in Coal.

M. R. CHAKRAVORTY & H. N. DAS GUPTA, Dhanbad.

The nitrogen in coal and coke is ordinarily determined by the Kjeldahl process. The process is open to objection as regards accuracy and the time taken. The digestion period has, however, been shortened by the use of different Catalysts by various workers. New processes, including those aiming at modification of the Kjeldahl process, have been introduced with a view to facilitating the accurate determination of nitrogen in coal and coke. It has been found by the present authors that by the adoption of ter Meulen's method (Rec. trav. Chim., 1928, 47, 698) with slight modification, it is possible to estimate the percentage of nitrogen in coal within a short time. Here the nitrogen in coal is made to combine with hydrogen in presence of a suitable Catalyst at a temperature of 310°C and the evolved ammonia is absorbed in a known volume of standard sulphuric acid solution. This permits the direct titration of the ammonia. The results obtained by this process are in agreement with those obtained by the Kjeldahl process.

24. Utilisation of low grade coals for steam generation.

S. G. MUKHERJEE, Kharagpur.

In future low grade coals with 25% ash content or more, high moisture content and in wide variation of sizes will be available for steam generation. The gratefired boilers which were previously designed and installed to burn good grade coals may be required to burn low grade coals. In this context the problems of combustion of low grade coals are discussed. The methods to overcome these problems, namely, blending, sandwich firing, steam jet ignition recirculation of hot gas and recovery of carbon in grits are discussed. A pot furnace has been designed to simulate the conditions as obtained in grate fied boilers. Preliminary experimental results reveal that the conditioning of slack coal has a beneficial effect of reducing the air resistance of the grate. The burning properties of a low grade coal e.g., coke breeze, anthracite duff can be improved by premixing with better quality coals. Several tests have been conducted on the pot furnace with blending of different qualities of good coals, low grade coals and clinker containing 15-20% unburnt carbon.

25, Road tar from Low Temperature Carbonisation tar by lime tar reaction.

D. P. AGRAWAL, M. G. KRISHNA & S. HUSAIN ZAHEER.

A road patch 30'×20'×2" was laid in the premises of the Regional Research Laboratory, Hyderabad Dn. in June 1954 using 'heavy tar' fraction obtained by Low temperature Carbonisation of Kothagudem coal in Lurgi Spuelgas plant, installed at Regional Research Laboratory, Hyderabad, and commercially available slaked lime as the binder for the aggregates. The proportions used were 4 cu. ft. of aggregates/16 lbs. of binder (heavy tar fraction + 10% slaked lime on tar basis + 10% Moisture on tar-lime basis). A 'light carpet' using 4 lbs. of binder per Cu. ft. of sand was prepared and laid on the patch. Present conditions after three years of use indicate that the base is still strong ; however the surface has become very rough and needs a further covering coat. The results are quite encouraging to take up larger experiments on the use of lime tar binders for road surfacings.

26. Fireclay Refractories Part I using Shekapur and Kamthana (Mysore) clays.

M. A. WAHAB and D. S. DATAR, Hyderabad-Dn.

A suitable composition has been suggested in this paper for making moderate heat duty group 'B' fireclay refractories using Shekapur and Kamthana clays and Katni bauxite grog.

27. Effect of Applied Stress and Plastic Deformation on the Formation of Martonsite in a High Manganese Austenitic Steel.

S. C. DAS GUPTA.*

Austenite-martensite transformation is known to be affected considerably by applied stress and the resulting plastic deformation. Generally, uniaxial tensile and compressive stresses both have been found to affect the Ms-point—tensile stress raises the Ms point whereas compressive stress may act either way. If compressive stress raises the Ms- point the degree would be much less in comparison to that tensile stress does. Hydrostatic pressure however definitely lowers the Ms-point in suitable steels. In this investigation effect of plastic deformation produced by compressing specimens under various conditions has been studied in a 16 percent manganese 0·44 per cent carbon steel. This steel was found to have Ms-point even below liquid oxygen temperature. In one set of experiments specimens after quenching to room temperature from the austenitizing temperature were compressed to different amounts, cooled to subzero temperatures and held is thermally at these temperatures. Amounts of martensite appeared to be practically un-affected by a cooling and isothermal holding at sub-zero temperatures but increased progressively with deformation. Some evidence was obtained that holding at room temperature after deformation quickly stabilised the austenite against further formation of martensite in deformed specimens on subcooling. Further confirmation is necessary in this respect. In another set, specimens after quenching were compressed at temperatures ranging fróm + 150°C to —183°C and held for different lengths of time isothermally without removing the compressive stress. Amounts of martensite progressively increased on deformation below + 60°C with lowering of temperature and size of martensite plates appeared to have increased at lower temperatures of deformation. Isothermal holding under the influence of the compressive stress did not materially increase the amount of martensite. In all the specimens martensite formed in very small sized plates preferentially within some deformation bands produced by compression. It was difficult in those specimens to make a quantitative estimate of the amounts of martensite microscopically. Hardness reading taken on the specimens confirmed the above results substantially.

28. Strain energy of the formation of Martensite.

DR. RAJENDRA KUMAR, Kharagpur.

The theoretical temperature of the start of the martensitic transformation (Ms) in steels can be calculated if it is assumed that the free energy change from 'gamma' to 'alpha' iron is zero at this temperature. Such a theoretical Ms temperature comes to be about 200°C higher than the experimental temperature and corresponds to a free energy difference of about 290 Cals per mole. This free energy difference is considered to be the "strain energy" of the transformation. It has so far been assumed that this is a constant. But detailed investigations conducted by the author have shown that the strain energy of the martensitic transformation in steels is not a constant, as has so far been assumed, but *depends* on the temperature of the formation of martensite and is *independent* of the nature of the allowing element. Its temperature dependence can be imperically described with the help of an equation:

$$\Delta U = 555 - 0{\cdot}61\ T.$$

where T is the Ms temperature in °C aind ∇ U the strain energy. It appears that the strain energy influences the Ms temperature to a greater extent and even outweighs the corresponding changes in the "chemical" free energy brought about by the alloying elements.

Further details are being published elsewhere.

29. The Random Abrasion of a Cu (110) Face.

Y. N. TREHAN and A. GOSWAMI, Poona-8.

A Cu (110) face was subjected to random abrasion under various cooling conditions. Dry abrasion resulted in appreciable disorientation of the surface layers accompanied by the formation of CuO and Cu_2O. No oxidation occurred when abrasion was carried out in the presence of excess of benzene. Rotational slip around the ⟨110⟩ axis was observed even though the abrasion direction was not preferential. The formation of the oxides has been ascribed to the rise of surface temperature during abrasion.

30. Structural variations in metals due to explosive stresses.

M. W. CHIPLONKAR & B. SWAMINATHAN.

In a previous communication Chiplonkar and Satyanarayana described and discussed the preliminary results of their investigations on the nature of the effects caused by explosive stresses on the structure and properties of metals. (Proc. Ind. Sci. Congress, Part III Abstracts, Section XIII, pp. 477-78). In the present paper these investigations have been continued further and extended to other metals also. In addition to confirming the previous conclusions regarding the shape deformities and orientations of fractures, the relation between hardness and grain size, etc. evidence has been obtained further of the influence of elongation of grain shape and their alignment along the direction of the plastic flow on the properties of the materials. In particular it is observed that at the places of sufficient but not too excessive longitudinal extensional stresses the plastic flow has produced definite structural changes, which give to the material directional properties. The microstructural study further reveals the phenomenon of shock twinning produced by the explosive stresses. The amount of grain distortion and grain twinning are both greatest in the region of considerable work hardening. (i.e. near the inner surface of the cylinders that we used in these experiments). The abundance of twins or Neumann bands decreased with the distance from the origin of shock waves. The results are discussed in the light of the present theories of work harding.

31. Underground Corrosion of Metals and Alloys.

B. CHATTERJEE, Sibpur.

In continuation of our work on the underground corrosion of metals and alloys, corrosivity of two soils, (I) from Mynaguri (Jalpaiguri) and (II) from Damodar Valley Area, for wrought iron and mild steel has been studied by measuring the weight losses on corrosion cell electrodes made of wrought iron and mild steel after exposure to these soils for 9 months in an atmosphere saturated with water vapour. With wrought iron electrodes, the combined weight losses of the anode and cathode have been found to be 0·18 gm. for sq. cm. and 0·022 gm. per sq. cm. for the two soils respectively. The initial cell current for the Damodar Valley soil has been found to be much less than that with the Mynaguri soil. Work on the underground corrosion of metals and alloys in relation to soil characteristics is in progress.

32. Studies in Hard Anodizing of Aluminium.

A. JOGARAO & B. SAMBAMURTHI, Karaikudi.

Hard anodizing is a comparatively recent development, not yet in wide commercial application. In view of the excellent properties of hard-anodized films, diverse special-purpose applications are envisaged. Among important recent processes, mostly patented, may be mentioned the Hardas and the M.H.C. processes.

Studies reported in this paper are confined to application of D.C. for anodizing in sulphuric acid solutions. The influence of current density, temperature and duration of anodizing on the general appearance, hardness and thickness of films produced was determined. Best results were given when anodizing was done at

36 amps. per sq. ft. current density, for 40 minutes duration, using 15% sulphuric acid at 5°C, with 3-5% oxalic acid or 0·05% potassium ferricyanide or 0·0025% ferric sulphate as addition agents. Films 2-3 mls thick, with pleasant dark-grey appearance and DPH numbers surpassing mild steel and hard-chrome plate could be produced under certain experimental conditions.

33. Production of Electrolytic Manganese Metal from Chloride Bath.

A. JOGARAO, Y. D. PRASADA RAO & S. GOPAL.

Electrolytic manganese (99·9 + % Mn) is recently gaining prominence as an important virgin metal both for non-ferrous metallurgy and for production of stainless-type special-purpose steels. Commercial production is already an "accomplished fact" in U.S.A. and probably in Japan and other countries. As against *sulphate-bath-electrolysis* which is the current practice abroad for tonnage-production *Chloride-bath-electrolysis* reported in literature appears to hold greater promise for a country like India, which is almost entirely dependent on foreign imports for her sulphur supplies.

Taking up *chloride-bath-electrolysis* therefore, investigations on indigenous manganese ores have been carried out by the authors, for determining the optimum conditions for continuous cell-operation. A large laboratory-plant has also been set up (10 lbs. of metal production per day) and operated successfully. Reduction efficiencies were over 90%. Leaching and purification were done in batches of 10 gallons at a time, recording 70% leaching efficiency. Passing 300 amps. current for electrolysis, 60% current efficiencies were recorded. Considering all facts, *Chloride-bath-electrolysis* appears to be preferable to *sulphate-bath-electrolysis,* for commercial adoption in India.

34. Effects of temperature and current density on the mode of growth of nickel deposits.

B. C. BANERJEE & A. GOSWAMI, Poona-8.

Industrial electro-plating of nickel is generally carried out under widely different conditions without considering the importance of various factors which control the crystal growth process. In the present paper, results on the effects of temperature (range 6°C—75°C) and current density (range 0·70—400 mA/cm^2) on the mode of growth of nickel deposits have been explained in terms of factors such as the rate of supply of metal ions to, and their discharge at, the cathode as influenced by hydrogen adsorption, and complex formation.

35. Utilization of one of our valuable minerals.

K. C. SOM, M. S. MAJUMDAR, S. R. BHATTACHARYA &
DR. G. P. CHATTERJEE, Howrah.

Our main aspect of investigation lies in the utilization of the vast resources of Titanium bearing Vanadeferrous magnetite ore economically. Firstly a valuable alloy of Ti-V-Fe which is regarded to be a tool steel composition has been prepared by Thermit Melting whose detailed procedure will be discussed in our paper. Next our experiment was carried out in obtaining the hard tool tips out of our raw ore well-ground and properly sieved and then mixed with suitable reagents. This hard-metal tipping has been again processed under two heads. The first one mainly based on power Metallurgy that is the raw ore was used in the form of pencil in presence of suitable binder and under pressure and subsequently subjected to the reduction process in hydrogen atmosphere under high temperature. Secondly the Titanium Carbide and Vanadium Carbide formed either under arc or under vacuum in an Induction Furnace. The details of some of these techniques have been briefly incorporated in the paper.

36. Recent advances in technical education in India.

Prof. J. N. BASU, Jadavpur.

Technical education in India had its first inception in the form of industrial schools in Calcutta and Bombay in the year 1825. Thirty years before this, John Anderson started a similar school in Glasgow for craftsmen, artisans, and apprentices. This has grown into the present Royal Technical College, Glasgow. The first technical school in France was in 1794 and in U.S.A. in 1823. The chain of German technological institutions (Technische Hochschule) was usherd after Franco-German war of 1872 ; the great Technische Hochschule at Berlin—Charlottenburg was founded in 1899.

From these it appears that India started technical education a bit later than U.K. and France but much ahead of Germany; but the progress and achievement were far behind the other countries. Technical education in India remained stagnant while other countries made enormous strides.

The drawback in quality and quantity in technical training in India are due to many causes such as political dependence, limited outlook with respect to functions of Indian engineers, want of research and post-graduate training etc. Even in 1915, the Indian Industrial Commission recommended against introduction of electrical engineering degree course in India.

From the time of the Second World War, things are changing for the better. The All India Council of Technical Education was formed by the Government of ·India. After Independence, both states and centre have taken effective measures for improvement and many new engineering and technological institutions have come into existence.

The total outturn in 1954 nearly at the end of first five year plan in different branches of engineering both for graduate courses as well as for diploma courses are given. The additional annual intakes are 83% for graduates and 266% for diploma holders, as suggested by the technical Man-power committee for which steps are taken by the All India Council of Technical Education. The annual additional intake during 2nd plan period shows increment of 2365/2847 x 100 i.e. 83% in degree courses and of 6040/2222×100 viz. 266% in the diploma courses.

The additional intakes are arranged region-wise according to requirements of technical personnel of different branches and cadres in the region, both by enhancing the facilities of the existing colleges and by starting new colleges in the region. The University Grants Commission kept in reserve an allotment, to be disbursed as grant, to engineering colleges on the recommendation of the All-India Council, which has fixed the rate of additional capital grant and additional recurring grant to the institution for each additional intake. The high percentage in the additional annual intake (266%) in diploma course is justified to keep up their present low ratio of intakes in diploma to graduate from 0·79 to 1·57 in order to avoid unbalance in the training of different cadres.

To improve training, subjects of 'industrial administration' and 'humanities' are intermixed with engineering courses ; Post-graduate training in the form of Master of Engineering, Ph.D and Doctorate in Engineering are initiated in several Universities in India. These are good signs indicating better outlook, proper direction to meet crying needs of the day. With these we can hope, India will soon turn out excellent engineers of international reputation, equal to many of his fellow-countrymen in different branches of art and science.

37. Engineering and Industrial Management.

RAMA G. KAMAT, Bombay.

Industrial management is essentially a function of the engineering profession. Only engineers have the technical background and the experience to lead workers. Both are fundamentally necessary for good and efficient management.

India needs efficient honest management for the purpose of bringing the Second Five-Year Plan to fruition.

At present, however, leaders in the field of industry come from chosen families or are creatures of bureaucratic training under our former masters, the British imperialists. They are neither technically nor morally qualified to lead our country in the new phase of its existence.

There is also a dominating sector under foreign management. It is not interested in the rapid industrialisation of the country.

Only Indian engineers with the necessary experience and knowledge of economics are capable of the good management of our industrial enterprises.

In a democratic and a socialist country, relations between the management and the workers cannot be based on the authoritarian system, characteristic of the colonial administrative machinery which we have inherited.

Mayo in the U.S.A., Stakhanov in the U.S.S.R. and others have shown how an improvement in human relations can increase productivity in industry. Only the engineer who is accustomed to lead workers on the factory floor, can transform the existing feudal and colonial relations into the socialist type, approved by the Indian people.

Corruption is the plague of our administrative machinery. It is an integral part of the system handed down to us by the British imperialism. In order to eradicate it, we must destroy the whole machinery and build a new one.

38. An Automatic Differential Thermal Analysis Apparatus.

K. S. IRANI & M. K. GHARPUREY, Poona.

A fully automatic DTA apparatus has been designed and constructed. The following are some of its remarkable features:

(a) The power to heat the furnace is supplied by means of a variable transformer driven by a specially designed cam and slow motion motor device. The shape and size of the cam were computed to obtain a fairly linear rate of heating for any desired rate between 2°/min. to 20°/min.

(b) The reference and the differential temperature are simultaneously recorded on a suitably modified Brown multipen recorder, thus facilitating a direct comparison of the two temperatures and considerably curtailing the cost of such a set up.

The equipment has been tried with a large number of known and unknown systems, and has given consistently good results.